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PRINCIPLES OF TAXATION.

By DAVID A. WELLS, LL. D., D. C. L.,
CORRESPONDANT DE L'INSTITUT DE FRANCE, ETC.

XIX.—WHAT SHOULD BE TAXED, AND HOW IT SHOULD BE TAXED.

SOME years since (1873) a citizen of Tennessee, Mr. Enoch Ensley, making no pretense of scholastic learning or private interests, but earnestly desiring the material development of his section of the country (Tennessee), and that it should not be retarded by the adoption of an unsound system of State or municipal taxation, published in the form of a letter addressed to the Governor of the State a little pamphlet entitled What should be Taxed, and How it should be Taxed, which set forth certain fundamental propositions in respect to local taxation, and supported them with such homely and clear illustrations as to entitle the essay to a permanent place in economic and legal literature.

Mr. Ensley commences by proposing the following rule or maxim as the basis for a State (Tennessee), city, or county system of taxation:

"NEVER TAX ANYTHING THAT WOULD BE OF VALUE TO YOUR STATE, THAT COULD AND WOULD RUN AWAY, OR THAT COULD AND WOULD COME TO YOU."

Mr. Ensley then lays down the proposition that property naturally divides itself into *two* classes—*movable* and *immovable;* that the former, as its name implies, can be moved from one place to another as its owner chooses, while the latter is fixed and can not budge an inch, no matter what its owner chooses. "I hold it to be true that immovable property has no value till it is occupied or

located upon, or brought to subsist or employ, movable property; and, as a rule, the more it employs or subsists, the more valuable it becomes; and the greater the inducements or attractions it offers movable property, the more it will have to locate upon it"; citing in proof and illustration the fact that the best acre of land in America is worth nothing till man goes upon it with his axe, horse, cow, etc., and puts it in cultivation and brings it to subsist himself, horse, cow, etc.; and from that moment it commences to have a value, by reason of the fact that it employs or subsists the man (who, if he can be called property at all, is certainly movable property) as well as the horse, cow, etc. And if this acre of ground for any cause should become attractive to and employ double the amount of movable property, it will as a general rule become doubly valuable; and so on, if it should become attractive to and employ profitably ten or a hundred or a thousand fold more movable property, it would become in like ratio more valuable, even up to the value of millions of dollars per acre, by reason of the fact that it offers attractions, and has employed upon it profitably five, ten, or fifteen millions of dollars' worth of movable property. Of course, when ground gets beyond a certain value it must be put to other uses than agriculture, and just this process acres of ground have doubtless passed through since the Dutch first landed on Manhattan Island.

There are exceptions to this rule—that immovable property is valuable as it has movable property employed directly on it—for it frequently has a greater value than movable property employed directly on it would warrant. It has a value reflected from the employment of movable property employed on immovable property near by, as in the case of residences in or near cities. For instance, the use of movable property on a Broadway lot gives a great value to the merchant's residence up town, by reason of the fact that it is sufficiently near and convenient for it to be in demand for the transaction of business daily at his store, all of which is attributable to the employment of movable property at the store.

The thrift or profit which immovable property offers to movable property helps to regulate its value. For instance, a man owns two pieces of property alike, say in different towns, rented out to merchants of equal capital; one is enabled to make seven per cent per annum only on his capital, for the reason that he has to pay three per cent tax on his capital, and the other makes ten per cent net, and pays no tax. The property paying ten per cent will be the most valuable, for it will pay the largest rent, because there will be more applicants for it than for the seven per cent; and the law of supply and demand governing, it must rent for more. It is, however, impossible, as a general thing, for these two merchants to remain of

equal capital. The ten-per-cent man will soon have more capital, from his extra thrift; and the seven-per-cent man, seeing his prosperity, is apt to pull up stakes and quit his town, and move to the ten-per-cent town; and other merchants will perhaps do the same thing, until, by competition increasing in the one town by other merchants coming in, and decreasing in the other by their going out, profits may be made the same. This, however, is not apt to make profits the same in a country like ours, for there is generally new trade to be looked up to keep pace with the newcomers. So the result would be that the newcomers would continue to go to the ten-per-cent town from the seven-per-cent town and other places, till the one becomes a large and prosperous city, and the other a dilapidated, languishing town. It will be easy then to say which storehouse is the most valuable.

In this there is little of novelty; but in the homely, clear illustrations which Mr. Ensley employed for impressing his fellow-citizens with the truth of his propositions, novelty is not wanting. Thus, for example, he says:

"I hold that, of all men, the real estate, or fixed property man, is most interested in the rule or motto I have adopted. To illustrate, I will say that there is an acre of ground in the city of Memphis, Tennessee, say in front of the Overton Block, that is worth at the rate of two hundred thousand dollars per acre, while the writer has an acre six miles below the city, quite as good naturally, and even better than the Overton Block acre, because it will produce more corn, cotton, pumpkins, peas, potatoes, cabbage, etc., than the Overton acre will, or ever would, and my acre is not worth one hundred dollars per acre. Now why is it that the Overton acre is worth two hundred thousand dollars per acre, and mine not worth one hundred dollars? The reason is that there is employed on the Overton acre, profitably, two, three, four, or five hundred thousand dollars of movable property, while upon mine there is employed the sixteenth part of a negro, the sixteenth part of a mule, plow, hoe, etc. Now, if you will manage in any way, either by taxation or otherwise, to drive from this Overton acre the two, three, four, or five hundred thousand dollars, and affect the Overton acre so that this capital, or any part of it, can not be employed on it with a profit, it will not be worth more than my acre—in fact, not so much, for there is nothing so valueless as ground covered with houses, when there is no demand for said houses. And, further, if you do anything to make the two, three, four, or five hundred thousand dollars pay less profit, you will damage the ground, or lessen its value, more rapidly than you will decrease the profits—not in the same ratio, but more rapidly. Suppose, for instance, the profit has been ten per cent net on the capi-

tal employed, and the property is paying a rental on three hundred thousand dollars; if you reduce the profits permanently, in any way, to five per cent net, the property would not pay a rental on one hundred and fifty thousand; in fact, it would hardly pay any rent at all, for five per cent would be too small to induce a business at all in this country."

"Movable property always seeks and locates on immovable property where it thrives and multiplies most rapidly. A spot of ground, a city, a county, a State, or even a nation, that offers the greatest thrift, will be sought and located upon by the greatest quantity of it, and the greater the quantity the more value and thrift will the land have. Any tax levied upon it lessens its thrift, and consequently is in violation of the correct principle; though it may not be enough to perceptibly affect it, yet it will have some effect. Though it may not drive any away, yet it will, to some extent, keep other movable property from coming."

"It is said that it was the last feather that broke the camel's back, while the first had as much to do with it as the last. An oppressive tax, such as exists in some parts of our State, drives off a good deal of movable property, and absolutely forbids any more coming to such parts, unless it comes relying upon dodging or evading the law, which large capital never does. Men of small amounts of money, goods, etc., such as one can hide, may come; but men of large amounts of money, to go into open banking, or merchandising, on a scale that can not be hidden, or evade the law, will not come.

"Here I wish to state a truism which, perhaps, many owners of real estate may never have thought of. It is this, to wit: The renter or lessee of real estate must always prosper before the owner of the real estate can expect to prosper. This is certainly true as a rule, when taken for a series of years, in a country like ours, where land is abundant, and the people free to go where they please. This will apply to all real estate, whether farms, storehouses, shops, or other kinds of realty. I don't mean he must have greater prosperity, but that he must prosper first."

"Of course, all mankind, where they have lived for a time, form local and social ties, and will submit to some oppression, though their property be all movable, before they get their consent to move away; but with the millions of dollars of movable property we desire to attract to us, no such ties exist; and if we do not offer quite as much thrift as other localities, and even more, when the property may be already located, we need not expect to attract it to us. But it is just as certain as that the law of gravity will cause the apple to fall toward the earth when it leaves the tree instead of toward the

sky; or as that water will run down an incline, if we (in Tennessee) do offer greater attractions than other localities we will attract it toward us, and the quantity and the rapidity with which it will come, can and will be measured by the amount of thrift that is offered. It is about as important to induce a man, with a given amount of capital, to come to us, as to retain one we already have in our midst, with the same amount." We can not expect to develop a State or build up large cities rapidly from their present population in their natural increase, but must invite others, with their capital, to come and settle among us.

"As I have said, any tax levied upon movable property lessens its thrift, and tends to drive and keep it away; consequently, it is incorrect in principle, while a heavy and oppressive tax is absolutely prohibitive and suicidal. Embraced in the rule I have presented in the beginning, never to tax anything that would be of value to your State, that could and would run away, or that could and would come to you, are two or three kinds of movable property which I regard as most important, and which I will mention—to wit, money, merchandise, and capital to be used in manufacturing. These pertain to cities mostly. There are many other kinds of property which, perhaps, would come under the rule, but for the present I will speak of these three, because through them great wealth generally enters the State.

"And here I desire to call your attention to the fact that the great bulk of the movable property generally enters a State or nation through its cities and towns—money and merchandise or trade always, and capital for manufacturing purposes most frequently; and from the cities and towns its beneficial effect is radiated throughout the State far and near, greater the nearer the city, but beneficial, to some extent, even to the utmost bounds of the State, particularly when we owe a common debt, as most of the States of the American Union do, and as our State of Tennessee certainly does, to the extent of over twenty million dollars. And here I wish to note the fact that there exists in Tennessee, in the minds of some of our farmers, or people living in the country, a prejudice against the cities. They imagine that the interest or prosperity of the cities is entirely separate from theirs, if not antagonistic; and again, the people of one part of our State imagine their interest to be separate from other parts of the State, which is incorrect *in toto*. This idea or feeling has, to a great extent, been manufactured by demagogues or ignorant politicians, and by newspapers actuated by incorrect motives or ignorance of the correct relations between cities and country, and the different parts of the State. This is all wrong, and the sooner the people turn a deaf ear to all such, the better it will be for all

parties. There is no antagonism of interest between them; but, on the contrary, a unity of interest. For a city to grow large, rich, and prosperous within the borders of a State that owes a debt to be paid by all parts of the State in proportion to the wealth of the respective parts, of course can not be against the interest of any part of the State or country; and *vice versa*, for the country to become rich and prosperous, it can not well hurt the cities; for East Tennessee to flourish, can not hurt Middle and West Tennessee, and so on. But, on the contrary, the prosperity of one is, and must be, advantageous to the other, not only so far as paying the common debt is concerned, but in divers other ways, such as the country patronizing the trade and manufactories of the cities, etc., and the cities, in return, buying what they may consume of country products from the country, and offering a near and convenient market for many of their products that can not be shipped to more distant markets, besides shedding or radiating an increased value on their lands in every direction, for miles and miles. To attempt to enumerate the various reciprocal advantages is useless, for the mind once directed to the subject, they become apparent by the scores.

"And here I desire to call the attention of the farmer or countryman to a fact that many have never thought of, which may tend to abate their hostility toward the cities. It is this, to wit: While it is impossible for a rich and prosperous farming country to surround a city without contributing to the prosperity of said city, yet it is possible for a city to be located within the borders of a State and grow to be rich, prosperous, and large, and to add great value to the lands around and to the State, without receiving a corresponding value from the country of said State. In fact, such is always the case where the city is large. For instance, the great city of New York is not indebted to the country or farm lands of New York for one hundredth of her prosperity and wealth. She reaps her wealth not only from all the States of the Union, but from all the civilized parts of the world; yet she don't contribute a dollar to the payment of current expenses and State debt of any State in the Union, or any part of the world, except the State of New York. She gives in her immense wealth to be taxed solely for the State of New York, thereby relieving each and every farmer in the State. St. Louis reaps a majority of her prosperity from other States than Missouri. New Orleans reaps four fifths of her prosperity from other States than Louisiana, and of Memphis it can be said, she has reaped of whatever wealth and prosperity she has, from a half to two thirds of it from Arkansas, Mississippi, southern Missouri, and southern Kentucky; yet she does not contribute a dollar directly to the payment of current expenses or State debt of any of these States, but it is

all taxed to supply the wants of the State of Tennessee alone. Nashville is similarly situated, to some extent, and perhaps Knoxville and Chattanooga, just to the extent that they may have prosperous trade beyond the State. Hence it will be seen that the farmers or country people should not be prejudiced against the cities located within their State, for they receive more aid from them than they give in return, and are consequently the gainers. So the practical operation of large cities seems to be to receive trade, and become rich out of it, from other States more than their own, and allow their own State alone to receive the full benefit, as far as her demands go. This, it strikes me, should not be objectionable to the farmer or countryman, or to the State or any part of the State. Consequently, by no means should they desire any law, of any kind, to exist in the land, whereby the cities are oppressed and kept from growing, when, by its repeal or modification, they would not be harmed a particle, but, on the contrary, be benefited.

"To undertake to enforce a very oppressive tax on money is ridiculous nonsense. It is impossible. The Maker of all things has forbidden it, in giving to all things their peculiar nature. He has forbidden an oppressive tax on money, by giving it such an easy mobility that it can go, in a fortnight, from Tennessee almost to the uttermost parts of the world. And just so, to some extent, with other kinds of movable property. It would be about as wise for the Legislature to pass a law enacting that, from and after this date, the great bulk of the water of the Mississippi River shall flow toward Cairo instead of toward New Orleans, as to enact that the great bulk of the money of Memphis shall pay four and a half per cent tax per annum. It is wise in man to deal with things as they are, and will be in spite of him, and not as he may think they should be. Don't kick against the pricks!

"Suppose that some city or town found it necessary, in order to pay current expenses, interest on debts, etc., to levy a tax of ten or fifteen per cent on all kinds of property, real, personal, and mixed, and that it was rigidly enforced. Does any one suppose that there would be any movable property there in twelve months to collect the tax from? No, sir; you would hardly be able to find a pocket handkerchief or a pound of coffee in either of these cities. But all the real estate, houses, etc., would be there still, but without tenants, and consequently, on account of the high tax and want of occupants, worth nothing. Suppose, again, it was possible to adopt a process to make the real estate worth something, could it be done by running the occupants off and receiving no rent whatever from it? No; it could only be done by adopting a process which would fill all of your houses with tenants, and secure to you a rental from them; and that

could only be done by allowing movable property to thrive, and by attracting a sufficient amount of it to you to occupy additional ground, and to pay additional rental until your rental would be more than the tax.

"I find, in submitting my views to intelligent men, that at first they oppose me, and invariably say it is right and just for all kinds of property to be taxed alike; they all receive protection from the laws alike, and of course they ought to pay alike. Now, this would do very well, and be good reasoning, if we had a Chinese wall around a State; a wall that man could not scale to go out or come in, and no railroad could go under, through, or over; and then I would favor the tax of everything, for then it would all be fixed property; it couldn't run away or come to you; but until that kind of arrangement is made I am not in favor of it."

Commenting on a rate of tax of three per cent imposed on all property by various cities of the Southern States (at the time of his writing, 1873), Mr. Ensley points out as one result of such a policy that it offered "inducements to banks to carry on business with small capitals, and rely upon deposits for their capital; in other words, to undertake to do banking business without capital. A bank with five hundred thousand dollars capital pays fifteen thousand dollars to State, county, and city, being five times as much as a bank with one hundred thousand dollars capital, when the bank with five hundred thousand dollars capital does the State, county, and city, otherwise, five times as much good in the shape of assisting trade, manufactures, and developing the various industries."

Commenting also upon the tax rate of four and a half per cent imposed at that time in the city of Memphis, Mr. Ensley further adds: "If you will levy, enforce, and collect such a tax on the money, trade, etc., of the great city of New York, and charge no tax in Boston, Philadelphia, or Baltimore, I will guarantee to transfer, in a short time, hundreds of millions of the trade, money, etc., of New York to those cities; and, if she will continue it five or ten years, I will guarantee to show you, in either of these cities, more trade, more money, and more people than in New York. I will guarantee to depopulate her more effectually and more permanently than a plague ever did a city, and impoverish her more effectually than ever a war did. Yes, I will hurt her infinitely worse than a fire, that might burn every house from Castle Garden, from river to river, to Central Park. I will make it entirely safe for women and children to cross Broadway at City Park, Astor House, Wall Street, or elsewhere, without the protection of policemen. I will reduce the value of the real estate of Mr. Astor from one hundred million dollars (it is said to be worth one hundred million dollars) to twenty-five million dol-

lars or ten million dollars, and perhaps even less, and the estate of every real estate or immovable property holder in the same ratio; but I can not say that I will greatly injure the movable property man, for he may go to Boston, Philadelphia, or Baltimore, and do quite as well as he did in New York city with his money, goods, etc. The truth is, it would entirely bankrupt the great city, for the demand for immovable property would not be sufficient to pay a rental sufficient to pay the interest on her city, county, and State debt. I do not think these assertions on the extreme, or the picture overdrawn. And if the picture is not overdrawn, and even say it is overdrawn by fifty per cent, who would be the injured party in New York by the enforcement of such a law? Would it be the great merchants who, for aught I know, rent their houses from Mr. Astor? Or would it be Mr. Astor, the great real estate owner of New York? In other words, would it be the movable property man, with his goods, money, etc., who can take it and go to Boston, Philadelphia, or elsewhere, and perhaps do quite as good a business as he did in New York, or would it be the immovable property or real estate man, who has to stay where he is and pay his city and county debt, without tenants or rental from his property? Hence, I say that, of all the men who should object to oppressive and, to follow the principle, I will say any taxation at all on money, merchandise, or trade, manufactories, etc., it is the man who owns the real estate or immovable property. His position should be this: He should say to the thousands of men in the civilized world, with their money in their pockets, looking out a favorable locality to go to banking, merchandising, manufacturing, or farming, etc.: 'Come, locate on me; I will not oppress you; come to me, for I can't go to you, and we must come together, or I am worth nothing; and knowing this, I will not tax you and oppress you. Other localities make you pay a tax; I will not, consequently I offer that advantage over other localities.' Heretofore it has been the merchant who has done the complaining about the tax levied on him; he is not the one to do it; it is the real estate man, and the writer being one of those men owning real estate almost entirely, and not owning a dollar's worth of merchandise of any kind for sale, and not being a lender of money, but, on the contrary, a borrower, and not being a manufacturer of any kind, and not being the owner of machinery, except a steam sawmill and a steam cotton-gin establishment, but being what is known as a plain farmer or planter by profession or occupation, thinking he sees his interest in the system he is advocating; consequently therein is to be found the moving cause of this letter.

"I contend that this system will lighten the burdens of taxation on real estate, and, after a very short time, the rate of taxation will

really be less. To illustrate further, I will say what I said to a prominent real estate owner in a conversation on this subject. He said to me: Do you say that such merchants or bankers shall make from ten to sixteen per cent on their capital, and pay no tax, and I make only six or eight per cent on the houses they are occupying, and pay all the tax? Yes, says I. You seek to tax them, and that is the reason you get no larger per cent on your property. Says I: If they make one hundred per cent per annum on their capital, you should not want them to pay a copper of tax. Why? Because if they made one hundred per cent per annum, next year you would have forty applicants for the house they are doing business in, and if you should, you would certainly get a full rent for it, more than the extra tax, and as only one of the forty could get the house, and the other thirty-nine would be unaccommodated, and if your tenants should be making this large per cent, it is reasonable to presume that they would be making it, or something near it, all over town; consequently there would be near the same number of applicants for every house in town; but as only the present tenants or their number could be accommodated with houses, the result would be that you would not only get exorbitant rents for all the houses in town, but you would have demand for the hundreds and thousands of vacant lots throughout the city to build storehouses on; they would either buy them or offer you such enormous rents as would induce you to build them houses on lots that you have been paying taxes on for years, and received no rental from. Soon there would be houses going up all over the city, block after block. The brickmaker would have more than he could do; the lumberman would have more orders than he could fill; the carpenter, bricklayer, stone mason, foundryman, and all descriptions of mechanics and laborers would have more than they could do, so that the builders would have to send elsewhere for mechanics, and they would come in by the thousands. All these newcomers in turn would want residences for their families; and thus would bring into demand and make pay a rental thousands of lots that have never paid anything, and you give active employment to all the mechanics you have, and besides bring thousands of others from other places.

"Let us go a little further, and see how it affects all and everybody in the city. These newcomers get their houses, and then they want furniture, and they patronize your furniture man; they want a carriage or wagon for family uses, and they patronize your carriage man; and then horses, and patronize the horsemen; and then the blacksmith to shoe them; and then the retail dry-goods houses, mantuamakers, milliners, grocery-men, butchers, vegetable market men, and, in short, every kind of retail establishment throughout the

city, thereby giving vigor, life, and thrift to all; and thus it would go on until, before you would be aware of it, you would have a city of hundreds of thousands of people, and be worth and pay a rental on hundreds of millions of dollars. Of course, no general trade would pay one hundred per cent per annum, but I have adopted this rate to illustrate the principle.

"The system of nontaxation of certain kinds of movable property, which I am advocating as the correct system, while it is the best to be adopted in every State, yet it will not make a rich State out of every State, nor will it build up evry town to be a large city, by any means. Thus, for instance, its application to a naturally poor State could not induce movable property sufficient to go there to make it a very rich State; still, if there is any way possible to develop such a State, this is the one.

"It think I have shown beyond question that it is not in harmony with the interests of any one in any State to tax money, trade, manufactures, etc., and that, of all others, the owners of fixed or immovable property should demand that the present system be changed—that they should say: Don't adopt any system that has a tendency to drive movable property from me; but, on the contrary, adopt a system that will attract it—for we are worth nothing without it, and the movable property man may go elsewhere and do quite as well."

SOME USES OF THE CAMERA IN ZOÖLOGY.

By R. W. SHUFELDT, M. D., C. M. Z. S.

PRACTICAL zoölogy in these days is realizing more and more the benefits it is receiving from the use of the photographic camera. These advantages are appreciated by naturalists, educators, and the reading public, and are seen to be advancing along a variety of lines; not the least important among these being the services accruing therefrom to the morphologist, the zoölogical artist and illustrator, and to the taxidermist. To the first named the assistance rendered by photography to his science has been some time established, having a number of years ago been placed upon a practical working basis. Its most successful operations are seen in the photomicrographs produced at the hands of the skilled laborers in such fields. Osteology is another department wherein distinct gains have resulted from photography. Bones and skeletons of every species of vertebrate are now illustrated in a manner that for beauty, accuracy, and permanency of the work, defies any character of illustration heretofore known, not even excepting the best grade of wood-

cutting, and to it it is superior in the matter of accuracy. Time, labor, and expense are also largely saved by the scientific use of the camera. For example, in order to produce a figure of the skeleton of some such medium-sized mammal as a cat for an octavo work upon osteology, the reduction and draughting often occupied an artist several days; the cost, in addition to his time and labor expended, ranging all the way from ten to twenty-five dollars; whereas now, by the use of the camera, not only are greater accuracy and beauty insured, but the resulting half-tone obtained is at a very moderate pecuniary outlay. In the matter of illustrating sections of bones there is absolutely no comparison at all, for it is quite out of the question for any artist to copy the delicate internal cancellous tissue of the bone, while a photographic picture, occupying less than an hour to secure, will exhibit all this detail with the greatest sharpness and fidelity. Passing to another field in practical zoölogical pictography, we find the works upon natural history published during the latter part of the last decade, in many instances, filled with figures of mammals, birds, reptiles, and fish, to say nothing of those of the invertebrata and plants, where not only the specimens are malproportioned, drawn in impossible attitudes, characterless, but are even in some cases totally irrecognizable. Then these figures too, or the wretched class of them to which reference is made, had come to be a species of authors' heirlooms, passing from one work on to the pages of the next published one, and so on, till they found their way even into lexicons and text-books intended for the instruction of students in schools and colleges. All this is especially objectionable, for it is fraught with the danger of teaching erroneous ideas in the very important matter of the appreciation of correct form or morphological accuracy in natural objects, giving our youth false notions of the appearances of animals of all kinds and descriptions.

Let any one examine, for example, the figures in literature of such mammals as the walrus or the seals, published not longer ago than forty years, and my meaning will at once be made clear. Indeed, it is only in very recent time, comparatively, that we begin to see anything like correct pictures of the fur seal, and the camera has played a very important part in securing these. Among birds, and particularly among reptiles and fish, the same objectionable features are frequently noticeable, and of the charge of all this the present writer considers himself by no means guiltless, for before the photographic camera came to his aid not a few of his own published figures of vertebrates would without question have passed into the same category. Since the camera has come to his aid, however, these have been supplanted by a class of photographic pictures of living

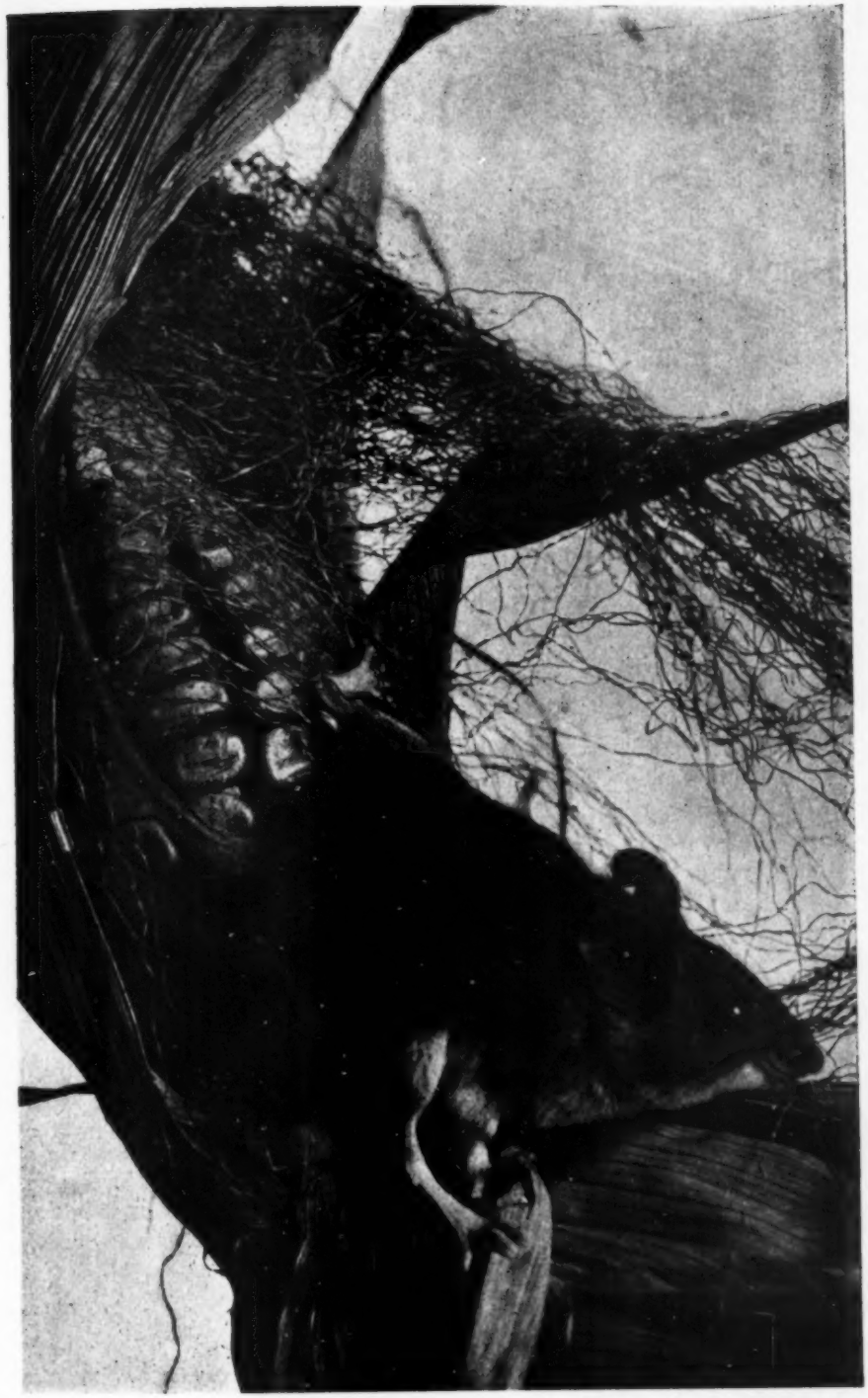

FIG. 1.—DEER MOUSE. Life size from living specimen. Reproduced from a photograph made by Dr. Shufeldt.

specimens, frequently taken in their natural haunts, that for accuracy and beauty defy criticism.

Upon the whole, the mixture of feelings is by no means pleasurable when he comes to examine, for instance, some of the drawings of mice he had the temerity to publish in a popular journal some dozen or more years ago, that came before the eyes of a very large constituency of readers and observers. Yet he can remember very well the time and labor that were expended in attempts to faithfully portray those beautiful little animals, so difficult of correct portrayal. Unsatisfactory in the extreme were the results, and disappointment the sole reward. How very differently does the camera do its work! Not so very long ago, having captured a fine living specimen of the common white-footed or deer mouse, the attempt was made to photograph this, one of the gentlest and prettiest little creatures in Nature. A result was obtained far exceeding the most sanguine expectations of the operator. Having placed an ear of ripe yellow corn, with husk and silk attached, the subject was induced to jump from the hand on to this as a perch. No sooner was this feat accomplished than he ran up and down it in a very excited, not to say interesting, manner. Already the ear of corn had been focused upon the ground glass of the camera box, and a holder armed with a very sensitive five-by-eight plate been duly placed in position. After having satisfied himself upon the state of things, my mouse suddenly paused and balanced himself to jump off, and if possible gain his liberty. In this attitude, and offering an opportunity not to be lost, an instantaneous exposure was made, and the plate removed to the dark room and developed.

This entire operation took no more than half an hour, and yet the outcome of the achievement was a picture of surpassing interest and accuracy, and one that even a rapid artist could not have produced in less time than a day, and then not have succeeded anything like as well. A reproduction of this picture is shown in Fig. 1, which for animation and fidelity to Nature would be hard to equal.

Similar and equally successful photographs have been produced by the writer of other species of mice, of young opossums, of the muskrat, and several other mammals. With respect to birds it may be said, by employing the same means in the same way, photographic pictures have been secured of upward of fifty species of those forms occurring in our United States avifauna. A certain proportion of these are of adult individuals, while many others are of nests containing young in various stages of development. Sometimes old birds, male and female, were secured together, in the most natural attitudes upon the same limb, as in the case of cedar birds, and a life-

size picture of two young catbirds, large enough to fly, was similarly obtained. Others in the collection represent vultures, hawks, owls, many warblers, Carolina paroquet, woodpeckers, crows, thrushes, and those of various other families and genera.

One of the chief beauties of such pictures is that by the use of the instantaneous shutter the operator secures a result with the subject in some attitude that even the very best of zoölogical artists fail in.

FIG. 2.—LONG-EARED OWL. Subadult; about one third natural size. Reproduced from a photograph of the living specimen taken by Dr. Shufeldt.

This is well exemplified in such birds as owls, and it is a fact long known that such an accomplished ornithological artist as Wilson complained in his work of the difficulty he experienced in even depicting these in conventional attitudes. Not so with the camera, however, for with it the adroit manipulator of the instrument catches them upon the sensitive plate in almost any posture he pleases. Many of these taken by himself are to be found in the writer's col-

lection. Last June Mr. Edward S. Schmid, the bird fancier of Washington, D. C., kindly loaned him a living specimen of a sub-adult long-eared owl, and this pugnacious bird soon proved himself to be a most capital subject from which to secure the more unusual attitudes so characteristic of the group. Having photographically pictured him in postures of rest, he was next teased to assume various ones of defiance, and these were secured with equal celerity and ease —not little, unrecognizable inch-high affairs either, but only a degree less than half natural size, capable of exhibiting all the external characters of the species. From the collection one of these is selected and offered to the reader in Fig. 2, and for a portrait of a defiant owl it is surely a very striking likeness.

Pictures as good as this one have been obtained by the writer of the screech owl, Aiken's owl (male and female in one print), the barred owl, and the barn owl, the last-named species being the most difficult subject of this famous family yet handled. Success was at last secured, however, where the specimen is shown (one third natural size) resting on one leg upon an old stump of a tree in a shady bit of woods. It has not at this writing yet been published.

Turtles, frogs, snakes, and lizards have been, to the extent of a score or more, taken with admirable success. My picture of the tree frogs has already appeared both in London and in New York, and the common bullfrog in Appletons' Popular Science Monthly. Forty or fifty have appeared in other places, and this is only noted here as proof of the practicability of illustrating zoölogical works by these methods, and in support of the fact of the way they are appreciated and utilized by naturalists.

Recently attention has been turned to the photography of fishes, a group of subjects presenting more difficulties to confront the artist and his camera than almost any other class. Nevertheless, success along these lines, too, is coming fast, and it is safe to predict that the photographic picture, in a vast number of instances, of ichthyological specimens will place the tediously produced pen-drawing in black and white in the background.

In July (1897) the Honorable United States Commissioner of Fish and Fisheries, J. J. Brice, Esq., at Washington, D. C., extended the writer unusual facilities to attempt some camera work in this direction at the aquaria of the Central Station. Without any special preparation this courtesy was almost at once availed of, and, although the circumstances were by no means the most favorable under which the first exposures were made upon the living fish in the aquaria tanks, yet some of the results were more or less gratifying, and certainly measured a standard of success sufficient to encourage other and more elaborate trials. Good photographic pictures

FIG. 3.—LONG-EARED SUNFISH (*Lepomis auritus*). One third natural size, from life. Reproduced from a photograph taken by Dr. Shufeldt at the United States Aquaria at Washington, D. C.

of sunfish (*Lepomis gibbosus* and *auritus*) were secured, as well as one of the common pike (*Esox lucius*). No less than twenty sunfish appear upon one plate, and in not a single fish is any movement discernible, the exposure having been made in less than a second. A very pretty result is seen in the male long-eared sunfish that was

FIG. 4.—PAPILIO TURNUS. Natural size, from life. Reproduced from a photograph taken by Dr. Shufeldt.

obtained, and this picture is here reproduced as a fair example of such success as attended the other attempts (Fig. 3). Where failures here were made, they were due to the insufficiency of light, the too rapid movements of the fish, and to reflections upon the glass of the aquaria. In a few cases all these difficulties conspired to defeat the hopes of the photographer.

Fortunately, however, each and every one of these drawbacks, save the second mentioned, can be overcome, and this the writer proposes to do in the near future.

Insects, again, make very instructive pictures as taken by means of the camera, though frequently they are secured with no little difficulty. Photographic pictures of this kind are in the writer's collection, showing beetles, spiders, butterflies, and the like, and a number of them have already been published. Great restlessness on the part of most of the subjects is here what chiefly has to be dealt with and overcome. The large black and yellow butterfly, taken life size, and shown in Fig. 4, occupied the best part of two hours to obtain. It was extremely restive, and declined over and over again to alight upon the day lily that had been selected for it as a perch. Still, indefatigable patience, the prime qualification for achievement in this field of art, in time won over the unintentional obstinacy on the part of this lovely insect, and victory finally crowned the long series of efforts made to secure its photograph. Nothing whatever can be gained here where harshness, haste, or lack of tact are allowed to come into play. On the contrary, one must not only be more or less familiar with the habits of the subject in Nature that he is trying to secure the picture of, but every act and movement on the part of the artist to accomplish this end must be characterized by extreme gentleness, patience, and perseverance, or else the desired goal will never be reached, and the science of zoölogy will forever remain ignorant of his power to produce portraits of living forms as they appear in Nature, by employing to that end such an instrument as the photographic camera.

MR. C. HOSE relates that one of the points of etiquette of the natives of the Baram district of Borneo forbids any man being called away from his meals; and it is even considered wrong to attack an enemy while he is eating. The people assume to converse with spirits and omen birds through the medium of fire. If a man hears the cry of a bird—which is a bad omen—he lights a fire and tells it to protect him. The fire is supposed to speak to the bird. The owner of fruit trees in fruit places round stones in cleft sticks near them, and utters a curse against any one who may attempt to steal the fruit, calling upon the stones to be his witnesses. If a friend passing by wishes to take some of the fruit, he lights a fire and tells the flame to explain matters to the stone, and that is supposed to make him safe. When a house is to be built, all the parts having been made ready to be put together and the omens having been consulted, every man, woman, and child in the neighborhood is called upon to help on a given day in erecting the structure; while a few small boys are sent out to beat gongs and keep up a din, in order that bad omens may not be heard after a good omen has been obtained.

THE EVOLUTION OF COLONIES.

By JAMES COLLIER.

II.—EMIGRATION.

EMIGRATION is a continual regenesis of colonies, and in its latest stages exhibits all the phenomena that belong to the beginnings of societies. It answers closely to the genesis of the individual organism in particulars not previously mentioned. It is a mere extension of the migrations of animals, which project light on it, as it reflects light on them. And it recapitulates the movements that peopled the countries whence it proceeds. Guided by this triple clew, let us explore its myriad facts. They may be conveniently distributed under the principal Aristotelian categories. Whence, by whom, and of what sort, when, why, how, and whither has emigration taken place? Which are the emigrating races? At what point in its history does a nation throw off a colony? What are the characteristics of the emigrating type? What are the classes, religions, and professions, and which chiefly the sex, that swell the stream? What are their motives for leaving the old and seeking a new country? Under what circumstances and by what agencies is emigration carried out, and in what direction does it move?—these are the questions to be answered.

I. It is the brilliant generalization of Weismann (with which his view of the intransmissibleness of acquired characters seems to have no necessary connection) that the substance of every species consists of a web of germinal protoplasm that is continuous from one generation to another—a warp whereon the lives of individuals are as patterns woven. We might similarly conceive the migrating (destined, when they reach the sea, to become the emigrating) *races* as forming a continuous emigrating chain or cable, unbroken from the departure of the first migratory band to the sailing of the last emigrant ship, splitting on this side and that into independent strands, but each containing the ferment of the movement that has carried civilization round the globe. The Carthaginians inherited a double portion of the Phœnician colonizing spirit. The Greek colonies gave birth to others which, like Massalia, Syracuse, Sybaris, Corcyra, and Andros, were more colonizing than themselves. England, the progenitor of a hundred peoples, is a Teutonic and Scandinavian colony. Massachusetts was the mother of a cluster of New England States, and Virginia of many of the Southern States. Two great colonies have sprung from the loins of New South Wales; two others from two New Zealand settlements; and both countries

stretch out their hands toward New Guinea and the South Sea islands, while they flood distant newly discovered gold fields with immigrants.

It is the *masculine* races that emigrate. The earliest of the great colonizing peoples, the Phœnicians and Carthaginians, in addition to the "strenuous ferocity" that marked the Semites, possessed an "individual impulse and energy" which (in Grote's opinion) put them greatly above the Egyptians, Assyrians, and Hindus. The Greeks were flexible and many-sided, and, being fractured into a hundred independent communities, had a self-organizing faculty which promoted emigration in many directions and diversified colonization. The manliest of ancient races, the Romans, overflowed equally in colonization and conquest. The now emasculated Spaniards and Portuguese were, in the fifteenth and sixteenth centuries, the most robust of European nations. In the sixteenth and seventeenth centuries the French were aggressive and conquering. The long struggle with Spain made Holland a nation of heroes. The English, Germans, and Scandinavians are Bismarck's masculine peoples. The Celtic Irish, the Italians, and other feminine nationalities have emigrated in profusion since emigration has been made easy.

The emigrating impulse is by no means diffused equally over the emigrating races; there are emigrating *sections* of these races. The migrating Aryans, whether starting from "somewhere in Asia" (as Max Müller still maintains) or from southern Russia (as Schrader contends), spread into every European country, and forming a fringe along the coast, where they remained as sea rovers, or crowding to its centers, where they became its rulers and its aristocracy, were the progenitors of the migrating bands which left these countries in after years or are leaving them now. "The cells in which the original germ plasm most predominates become the reproductive cells." Thus the early colonies of Spain and Portugal were settled by Biscayan and Guipuzcoan mariners and by the flower of chivalry at the seats of military enterprise at Cadiz and Seville. Breton and Norman seamen and merchants of Saint-Malo planted the first French colonies. Devonshire gentlemen and sailors led and manned the buccaneering and exploring expeditions that were the parents of the American colonies; Devonshire and the adjacent counties contributed one sixth to the Puritan exodus and, only half a century ago, founded a colony in the South Seas. Two thirds of that exodus were made up of the descendants of Norse sea rovers on the Lincolnshire seaboard. It points likewise in the direction of a continuous migrating element in stationary masses that emigrants are drawn unequally from the different races of the mother country. Thus the masterful Scottish nationality, once so vagabond, has left a

"broad and permanent impress" on the middle belt of the United States; has more than its share of population and power in Canada, where it pioneered the Northwest; in Australia, where the Queensland sugar planters and most of the large landholders are said to be Scots; and in South Africa.

II. The masculine races colonize and emigrate at a *point of time* after the attainment of national manhood. National puberty manifests itself in the feverish excitement of provincial rivalries and civil wars. National manhood shows itself in a nation's becoming master in its own house. Spain expelled the alien, unassimilable races of Jews and Moors. The French monarchy subjugated the provinces. The English brought the civil wars to an end. The Dutch threw off the Spanish yoke. Germany annexed the German portion of Denmark, extruded the heterogeneous Austrian domination, and, emerging victor from the struggle with France, unified the empire. Aggressive action ensues, as when a new professional man measures himself with rivals; if a nation can invent a new weapon, as a young business man a new process, the chances of success are multiplied. The Phocæans, the boldest of Greek mariners, conducted their trading voyages in armed penteconters, and, gaining a naval victory over the Carthaginians, established the colony of Massalia in what might almost be termed Carthaginian waters. The Corinthians invented the trireme and colonized. Their own colonists, the Corcyreans, were soon able to cope with the mother city on the sea, and then *they* colonized. The Greeks supplanted the Carthaginians. The Romans swept both from the sea, and recolonized the colonies they had abandoned. The Dutch, Spaniards, and French have lost many colonies to victorious rivals.

The surplus energy of a young nation will overflow in conquest or colonization, according to the time. It was after the struggle with the Moors, when Spanish chivalry was set free for new exploits, that Spanish ardor poured itself upon distant colonies. Surplus soldiers in England under the pacific James I, in Scotland after the plundering Borderers found their occupation gone with the Union, and in the same country after 1745, became colonists.

Colonization is precipitated by the maritime character of a country. Phœnicia, Greece, and England are notable examples. Colbert estimated that in 1669 the Dutch possessed a commercial fleet of fifteen or sixteen thousand sail, while populous France had five or six hundred ships at the most. The English and Dutch had a larger naval experience and markets over sea which they had frequented for a century. The Germans have few ports, and till lately have had neither merchant ships nor navy; Germans have accordingly emigrated in English vessels, and there are still few

German colonies. There must be surplus capital, as there was in Holland in the seventeenth century. Scotland had to strip itself of half its savings to equip the Darien expedition. Colonies that arise from the outflow of masculine vigor in these several forms might be called energy colonies.

Stud cattle are kept rather under condition, lean women have most children, and the number of the offspring depends mainly on the fertility of the female. As the feminine elements in a country reach maturity, as there are order within and peace without, the size of families increases, and the population presses on the means of subsistence. Hence statistics show that emigration is greatest in least prosperous years. Periodically, the pressure reaches the point of famine, due to the failure of a crop, or to devastation, or war, or changes in the mode of cultivation. The Greek colonies of Cyrene and Rhegium, those of the Sicilian Mamertines, of Virginia, and of the (English) Cape of Good Hope had this origin, and might be called distress colonies. The emigration after the Thirty Years' War, the long European war of 1793 to 1815, the Irish famine of 1845, and the Sutherlandizing of parts of Scotland, was distress emigration. Normal emigration is determined by the surplus birth rate. With one hundred and seventy-one births to one hundred deaths the United Kingdom is the most emigrating of all peoples, past or present; Germany, with a surplus of sixty-one, has been long the chief emigrant nation of the European continent; while poor France, with her one surplus birth, is in no position to colonize the territories she feverishly annexes. If the foundation of colonies is a consequence of military or naval power, the settlement of them is, therefore, a "function" of the excess of population.

The power to reproduce itself declines in a nation with age, as it does in an individual. Were there space enough, it would be easy to show how all the other signs of old age are traceable in the senile peoples that have ceased to colonize.

III. The *type* of successful emigrant repeats that of the mother country at an earlier stage. In the trappers, hunters, and traders of old Canada and new Oregon—often coarse, audacious, unscrupulous, but possessing endurance, courage, sagacity, and resource—Parkman finds realized "that wild and daring spirit . . . which marked our barbarous ancestors of Germany and Norway." The same type, its good and evil qualities softened by time and a less harsh environment, is still to be met with in colonies of recent foundation. 1. The emigrant must be physically robust. It is the brute forces that are most required when the resistance encountered is often that of Nature herself. Sometimes it is recorded on a tombstone that he who lies below was originally of "iron constitution," broken by the toils

of a pioneer existence, and many a silent heroine, the worthy mate of such a settler, has sunk under its privations. 2. The moral attribute most needed is forcefulness of character. Determination and tenacity, often rising (as lately in Rhodesia) into "splendid self-reliance" and devotedness, are the notes of the successful colonist now as ever. Will and not intellect is his *differentia*. 3. Yet high intellect always springs up to meet the demand when new molds of social life are to be framed, and disappears or flows into other channels when the necessity for it vanishes. The group of statesmen who drafted the Constitution of the United States, and the politicians who nursed the Australasian colonies through the perils of infancy, have had few equals.

IV. A polyp will reproduce itself, however small the fragment, if it have within it samples of all the different kinds of cells. A nation, in order to be fully reproduced, must likewise send out representatives of all its essential *classes*. 1. Many princes have migrated to ascend a throne, and two have emigrated—a Braganza to Brazil and a Hapsburg to Mexico. 2. Miltiades colonized Thrace, and one of the Bacchiadæ colonized Ortygia. Counts of the empire settled Davos and other mountain districts in German Switzerland. Hidalgos and other members of the royal household joined the second expedition of Columbus, and many of the members of the third colony sent out in his time belonged to the best families in the kingdom. Rich nobles sold their estates, as their ancestors had done in the time of the Crusades, to follow Cortez to Mexico and Pizarro to Peru. These two waves spent, the inferior nobility alone henceforward emigrated. Representatives of the lesser French nobility, like the Barons Poutrincourt and Castin, with Gascon and Norman cadets, were leading or degenerate colonists in Canada, where also many noble ladies contributed their fortunes or spent their lives in mission work among the Indians. In the seventeenth century a Scottish nobleman (the Earl of Stirling) endeavored to colonize Nova Scotia, and early in the nineteenth another (the Earl of Selkirk) led a colony of fur traders to Red River, having previously made a settlement in Prince Edward Island. Sir T. Temple ruined himself by generous efforts to build up a colony in Nova Scotia, and the story of the gentlemen adventurers in Acadia is long and interesting. Some of them, like La Tour, remained in the colony and left descendants. The so-called "nobility" of Carolina toward the end of the seventeenth century was a mere upper class. Even the Virginians, who have boasted of being descendants of the Cavaliers, are stated by Bancroft to have belonged to the middle class. Yet many of the loyal nobility fled from England after the execution of Charles, and these settled in the Southern States. Penn and Balti-

more for a time personally administered the colonies they led. When a genuine enthusiasm excites a whole people, the nobles share in it, and three hundred of the twelve hundred who formed the first expedition to Darien were of the best Scottish families, while some members of the second were Highland chieftains. Several baronets and sons of peers took part in colonizing New Zealand, and a baronet led the Jamieson raid. Only a few years ago an ancient English earldom threatened to become extinct in South Africa through miscegenation. 3. The great middle class, seat of the solid qualities in every country, was long the chief fountain of emigration. It alone, or it chiefly, had the means to emigrate, and the intellectual and moral energy to make the emigrant's life a success. "The immense majority of American families," Bancroft tells us, in both New England and the South, belonged to this class. Far the larger proportion of unassisted emigrants to British colonies during the present century has had the same origin. 4. Now that emigration is comparatively easy, the greater number of emigrants are artisans, laborers, and domestic servants, who thus assimilate colonies to the ratios of the mother countries.

V. Priestcraft did not emigrate, says Bancroft of the North American colonies generally. Yet, when a colonizing enthusiasm takes possession of a community, especially if the settlement is to be formed on church principles, *clergymen* often make great sacrifices to participate. The colonies of New England, Canterbury, and Otago were well supplied. A minister was sent out with the Darien colonists. In ordinary emigrations they are apt to be in defect. A bounty was offered in Virginia to immigrating clergymen. The hard country, the poor pay, the cavalier treatment, and the rough life deter even a "stickit minister." Those who succeed as emigrants are therefore of tough fiber, and possess the hardihood of character needed to hold their own with an untender race. As the colony develops, the more average members of the profession find their way out, and to a late stage in its history the majority in all the professions are of home birth or education.

The author of the Scarlet Letter ascribes the lack of *physicians* in New England to the undoubted materialism of the profession, which prevented them from sharing the impulse to emigrate. But the scarcity was not peculiar to the medical profession, nor was it confined to New England. Surgeons were as rare in French Canada, where "there was not a man who could set a bone." They are equally lacking in young colonies at the present day. The colonists are too few, too scattered, too poor, and too healthy to require or to be able to pay for them. Many a colonial township has starved out a succession of would-be medical residents. Those who thrive

are of the rough-and-ready type still to be met with in English country districts—men who have picked up their knowledge in the course of practice, and are better qualified to treat the diseases prevalent in simple than in more advanced communities.

VI. The "male cells are always more anarchic, usually mature before the female elements, and even in plants, and in such passive animals as a sponge or a hydra, burst from the organism, while the female cells remain *in situ*." * It is in accordance with all organic evolution that the male leads and the female follows. Male birds earlier migrate. The first Greek emigrations were exclusively of the male *sex*. Even the organized colonization of Cyrene was womenless. The northern invaders, having fighting to do, were solely men. No women went out with the first expeditions to New Spain. There were few women in early Virginia. There were few in New France for long, nuns excepted. The two colonies sent out to Darien consisted respectively of twelve hundred and thirteen hundred men. It is males that are wanted in a new country. Only men could fight the battle the early colonists have to fight; hampered by women, they would fight it worse or not at all. Heroines like the wives of La Tour, Dupleix, and many an unknown settler are equal to men, but women of a softer stamp suffer greatly and eventually succumb. Nor are they imperatively required; there are native women for the first immigrants, who are not as a rule squeamish. As the conditions assimilate to those of older countries, the proportions change. In a newly settled pastoral country the males are as ten to one. In older pastoral countries complicated with newly discovered mines, like West Australia, they are still as two to one. The emigration to New South Wales in 1831–'37 was of one hundred males to thirty females. The emigration from Great Britain at this day continues predominantly male, but only in the proportion of ten to seven.

VII. The *age* of the reproductive cells must be left in the obscurity in which it lies. Parent birds migrate before the young, but it is probably the more active and the less old of these that are the first to leave. The law remains operative to the last. The first emigrants are fighting or toiling men at their best. As colonial life grows easier, older and younger members of families join the stream. In rare cases an aged father and mother are brought out by a son who has thriven. Still (if observation may be trusted), nine tenths of emigrants are under forty-five, and two thirds of them are under thirty-five. Manhood in its prime and womanhood in its bloom form the core of all emigration. White heads are singular in youthful communities.

* Geddes and Thomson. Evolution of Sex, p. 241.

VIII. The dominant *religion* of emigrants is that of young and aggressive sects. Heretical Paulicians and Waldenses, independent Puritans, self-illuminated Quakers, spiritually minded Moravians, rebel Huguenots and Covenanters, disrupting Free-Church Presbyterians, and High Churchmen advancing to the conquest of the Church of England, have been the successful colonizers. The story of individual emigration has the same purport. Two thirds of the population of Carolina were Dissenters. The Methodists and Presbyterians, and these probably the last hived-off sects of the one and the schismatic denominations of the other, have each emigrated to Canada more numerously than the Anglicans. Australia is predominantly Anglican and (thanks to recklessly administered state aid) largely Catholic, but the Presbyterians and Methodists, Congregationalists and Baptists have all emigrated in higher proportions than exist in England. Of the United States it is needless to write. Within the last fifty years there has indeed been a copious immigration of the oldest of churches, but that from Ireland has been motived by political rebellion and that from Italy by social discontent; while there is probably not a European sect, community, or craze that has not sought a home in the wide, free spaces of the West.

IX. "Hunger is a dominant characteristic of living matter," and the lifelong hunger of the individual protoplasm is repeated in the social protoplasm. Birds and quadrupeds migrate for food, sunshine, and warmth. In a troop of horses or wild cattle a young stallion or bull gathers together a few heifers or young mares, possibly fights a battle with the old chief, then leaves the herd and seeks new pastures. The same thing is said of apes, and might probably be said of all polygamous animals. Monogamous groups drift apart by the mere law of growth. Finally, animals may be driven from their habitats by persecution or violence. All *motives* of human migrations and emigrations are reducible to these five—hunger, cold, lust of dominion, love of freedom, and public or private oppression.

1. Persons of all degrees of competence, from the capitalist who disembarks at Hobart with £25,000 to the quarryman who lands at Brisbane with fivepence, are continually seeking to better themselves. The craving is seen in its crudest form in the gold hunger. "I have come not to till the soil," said Cortez in Mexico, where he was offered a tract of land, "but to find gold." It is more reputable, but is not a whit more honorable, in high financial circles: the Grotes and Goschens, Barings and Rothschilds, who migrate from Holland and Germany to England, are governed by precisely the same motive as the gold digger. The earth hunger ought to be a shade less repellent, and yet the land sharks who infest young colonies are at once less honest and more avaricious. Higher wages and more continuous

employment will at any time attract emigrants. The less successful members of the professions naturally look to new emigration fields. Just fifty years ago a young engineer who was crowded out of his profession had resolved to settle in New Zealand, but, receiving a small apppointment, stayed on in England to become the most eminent philosopher of his age. An ex-Lord Chancellor relates that he and another briefless barrister, the present Speaker of the House of Commons, were at one time on the point of emigrating to "the colonies." Some have their career prepared for them before they start: bishops, professors, certain officials and experts generally, the flower of a nation's culture and of late growth, are regularly exported from England to her colonies, and even to the United States.

2. Human beings are less free to travel than swallows or lemmings, and they can temper a northern winter by warmer clothing, shelter, and fire. But even so there are many English families and still more individuals who regularly or occasionally hibernate in the Riviera, Algiers, and Egypt. Others expatriate themselves for a time or for life. The Brownings made a home in Florence till the lady's death, and Aristophanic Frere endured lifelong banishment in sun-baked Malta. It is usually to warmer latitudes that migrants move who are "ordered south," but Symonds found health in the snow-clad solitudes of the Engadine. Those who emigrate from such motives are more remarkable for quality than number. The statesmanlike organizer of a New Zealand province was a consumptive. Consumption sent Richard Proctor to observe the "larger constellations burning" in the "happy skies" of Florida, and thither also bilingual Edmund Montgomery; to Queensland it dispatched Clement Wragge to found Australasian meteorology. The literary worker whose strength has given way rejoices to have escaped from the fogs and darkness, the cold and wet of a London winter, and feels his sense of well-being heightened in the light air and unfailing sunshine of New South Wales. Not invalids only, but almost all, gain by southing. The Sutherlandizing of the north and west of Scotland excited indignation, and the inflamed imagination of the sentimentalist saw "the heather on fire"; but the Highland crofter who barters his miserable patch in the rainy Hebrides for a farm in Natal or Otago makes a blessed exchange. Whole peoples move southward with the slow, resistless motion of the glacier. The pine tree longs for the palm tree, in Heine's song, and the Russian advance toward Constantinople is doubtless accelerated by the snow and ice of the declivity.

3. Ambition is an old motive for emigration. The Andræmon or Androclus who led a Greek colony to the shores of Asia Minor intended to remain as its *tyrannus;* and so have most of the leaders

of modern colonies, from Columbus to Cargill. Even "celestial minds" are sometimes governed by the primary passion of the male animal in its most spiritual form. Pythagoras, unable to gain hearers or found a school in Samos, emigrated to Croton, where he established the Jesuit order of the ancient world. Xenophanes emigrated from Colophon and finally settled at Elea, which thence gave its name to the loftiest of Greek philosophic sects. The motive is operative everywhere and everywhen. It impelled Aquinas and Scotus from Italy and England to France; urged Niebuhr, Bernstorff, and Moltke from Denmark to Prussia; attracted Rossi, Scherer, and Cherbuliez from Geneva to Paris; and led Boyesen to New York. The fact that an immigrant to the United States may rise to any position save that of President is known to be in the minds of young Germans who seek a freer country than their own. The consciousness or the conceit of ability makes many a youth restless in the narrow environment of a Scottish or English country town, and, learning that push and volubility, as well as genuine talent, may carry a man to high political office in a British colony, he emigrates to become (what some have been styled) a "colonial Gambetta."

4. Freedom is as alluring as power. The artisan who is constantly being involved in strikes of which he disapproves emigrates to a country where trades-unionism is in its infancy. The independence of the colonial workman excites the envy of his English rivals. Staid elderly men look back with regret on the free life of the gold fields. Protestant Irish farmers, of Scottish extraction, emigrated last century to become freeholders in the United States. Frenchmen who have returned to France go back to New Zealand, unable to bear the constraint of overcivilization. The same passion for freedom in higher things carried Puritan and Moravian, Puseyite and Free-Churchman oversea for liberty to worship God in their own way. Enthusiasm for political liberty took Forster, Paine, and a crowd of dupes to France after 1789. The same feeling sometimes makes men retire from the world. Ulysses hoped to "touch the Happy Isles." Hamilcar Barca longed to escape from the turmoil of Carthage and sail for the fabled islands of Atlantis. Shelley, Tennyson, Mrs. Browning, and many plainer folk have cherished the same lotus-eater's dream. The disillusioned ex-governor who returns to spend the evening of his days in a Pacific paradise within the waters of the colony he once ruled is a type of the few who realize it. Do they always find the peace they seek?

5. Public and private oppression has made many migrate or emigrate. The Ionians and Syracusans who were driven westward by subjugation or sedition had no choice. The conquest of their

country before and after the fall of Byzantium in 1453 scattered educated Greeks over Italy and so cross-fertilized modern Europe. "The vices of European governments colonized North America." The revolutions of 1848 sent Follen to the United States and Foscolo to England. The *coup d'état* of 1851 had similar effects. "The great silence of the empire," as Zola calls it, which made it hard for liberals to earn a living, diverted Jules Simon into publicism and politics, and drove another eclectic, his friend Amédée Jacques, to seek death in South America. The conscious oppressiveness of an aristocratic system of government made Goldwin Smith a Canadian. Private persecution, which pursued Byron to Venice, chased the younger Arago to South America. Disappointment sent an unappreciated poet, Charles Wells, to lifelong exile in France, took George Brandes to Berlin, and has taken many to the colonies. Defeated men used to retire to the cloister. They now migrate or emigrate.

X. The earliest *mode* of emigration—that of roving adventurers on the seas—might be assimilated to the spawning of fish or the effusion of the male element generally. It is exclusively masculine, and retains this quality to the last in the person of every emigrant who embarks for a new country at his own expense, there to make a living in ways of his own. It soon takes on a partially assisted character in the equipping of the ship by home merchants. These develop into commercial or colonizing companies, which acquire (or seize) colonial lands from the natives, and then send out emigrants who buy land from the company, together with artisans and laborers whose passages are paid for them. Such emigration might be described as mixed masculine and feminine, and this form long continues. There is a third stage where (as in England after 1830) philanthropic associations dispatch pauper or partially assisted emigrants. The third is supplemented or superseded by a fourth stage, when a colony sends for immigrants, wholly or partly defrays their passage, and provides for them on their arrival. This least independent method of emigration, as the antithesis of the earliest masculine mode, may be considered exclusively feminine.

Emigration, like the migrations of animals, is *collective*. Though the vast Aryan migrations, so ingeniously charted by Pictet, may prove mythical as well as legendary, authenticated mass movements occur all through history. The earliest emigrations were of small accidental aggregations without adhesion. The next were great organized bodies. The emigration in our own days, of individuals and families who go out to kindred or friends, is really group movement of a highly organized character.

Like the lower migrations, emigration is rhythmical. The

burst of Greek colonizing activity which peopled Italy and Sicily was followed by a pause of forty years. After the Puritan exodus there was no emigration to New England for nearly a century. The rush to the Australian gold fields more than doubled the population in ten years, and then fell permanently to half. An eloquent propaganda sent a tidal wave of emigration to New South Wales in 1861–'63, only to sink in just the same space of time to its former level.

Migration and emigration are alike *periodic.* Swiss cowherd and Lapland deerherd, French workman and British invalid migrate only for the season. Fishermen emigrate for the season. Most of the first emigrants to new colonies intended to return, and many of them did and do return, but ever fewer with successive years. They compensate for this ascent above the animals by being migratory within their new area. Americans and Australians, New-Zealanders and South Africans have no homes.

There is a heightened temperature in plants before flowering, in lower organisms before budding or fission, in the lower animals at pairing, and in human beings during courtship. So is there among peoples at great colonizing periods. A "fever of emigration" partially depopulated Spain after the discoveries of Columbus and again of Balboa. The settlement of New England and Pennsylvania was preceded by growing and widespread, if subdued, excitement. Three successive waves of colonizing enthusiasm swept over England and Scotland in the forties. The gold rushes to California and Australia in 1847–'51, and the milder sensations of Kimberley and the Transvaal, Coolgardie, and Klondike, partook of the same character. And still, in some remote Swedish village, an emigrant to the United States or Australia will create a "fever" by the tidings he sends home of success or better days. Then it gets into the blood, and they can not stay. A "colonizing fever" is admitted by observers like the Duc de Broglie to reign at present in France, and is alleged to exist with equal intensity in Germany and Italy, while it is said to be redoubled in England, where it is normal and in the temperament.

At efflorescence, fission, budding, and parturition there is a "disruptive climax." So is there in colonization and emigration. Esquiros has given a pathetic account of a visit to an emigrant ship at the London docks. William Black has described, and some artist has painted, the departing Highland emigrants as they sing Lochaber No More. As the white or the dark cliffs fade, the lump rises in the throat, the eyes fill with unwonted tears, and those who are gifted that way break into verse. Byron's wild Good Night!, Edward Bliss Emerson's melancholy Last Farewell, Hugo's vicarious Sea Song of the Exiles, and Australian Gordon's Exile's Farewell

give moving expression to universal feelings. It is, in truth, a "terrific wrench." To leave (forever, as it may seem) the happy scenes of childhood and youth, associated with all the sentiments of the prime—its golden dreams and first love, the growing passion for knowledge, the dawn of religious faith, visions of wider horizons, the stirrings of ambition and the hopes of future usefulness—and to settle in a new, strange land, perhaps half inhabited by savages and but partially cleared, with incredible wooden houses and many things still in the rough, is a unique experience. The psychologist in search of fresh material for his much too impersonal science might be (but is not) advised to cultivate the sensations of the immigrant who lands at the antipodes and doubts whether he is rightly perpendicular. A cry of joy leaps from him as he first hears and then sees the skylark mount, and feels that, after all, he can not be far from home. But it is long ere he is thoroughly acclimatized, and if he has emigrated late there is to the last a consciousness of "something wanting."

XI. Animal and human migrants follow the southing sun. Swallow, lemming, bear, and wolf are forerunners of the Auvergnese, Switzer, and Laplander who descend from mountain to plain as winter approaches, and of the invalid who seeks the sunny Riviera or the rainless Nile. The first Spanish and Portuguese colonies were planted on the same southerly slope. Then Europe spread its wings for a bolder flight, and the drift of emigration has since, as it mainly had ever, been toward the setting sun. Yet the *direction* is by no means uniform. The Hellenic migrations poured downward through Greece and, overflowing into the Ægæan islands, colonized Asia Minor. The Hellenization of Asia by Alexander was a movement toward the east and south. The Gauls marched eastward to Galatia. A regression of the Teutonic race under Charlemagne in the eighth century founded the two great German dynasties of the present day. The Crusaders, Venetians, and Genoese conquered and colonized eastward. The largest wave after the American has taken a southeasterly course to Australia. Smaller streams of French, Italians, and Spaniards flow to Algeria and Tunis, and a mixture of nationalities to Madagascar, while East Indians pursue nearly the orthodox line to Guiana and Mauritius, or diverge to the Straits Settlements and Fiji. An increasing volume of emigration is being directed south and southeast to South Africa or due east to China. But these will prove only eddies and backwaters in the steadily westing current. It will be by America that the European nations will return to their fabled birthplace.

While the drift is apparently overmastering, the exact direction is often, as with birds, a matter of accident. Tyrians were driven

to Cadiz, and Greeks to Libya and Sicily, by stress of weather. Columbus struck Hispaniola on his imagined way to India. Hudson embarked on a Saul's voyage in search of a northwest passage and found New York. Fishermen were blown south to the Canaries and west to Newfoundland. The settling of Plymouth was an accident of the weather, and of Virginia and Botany Bay an accident of discovery.

Yet accident plays its Darwinian game within narrow limits. Deep affinities and irresistible magnetisms mark out the paths of emigration. 1. Colonization follows discovery at unequal intervals. It followed that of South America instantaneously; more or less successful attempts at it in North America were at no great distance. The Cape of Good Hope was colonized by its discoverers, the Portuguese. Dampier discovered Australia in 1688, but it had to be rediscovered and explored by Cook eighty years afterward before it was settled in 1788. The colonization of New Zealand took place half a century after its discovery. 2. Distance is the primary factor in determining the order of colonization. That South America was settled before New England was partly an accident of discovery, but, once it began, the stream of emigration flowed and still flows in far greater volume to the nearer colonies. Out-of-the-way South Africa has not until lately allured emigrants, and the remoteness of Australia and New Zealand has all along deterred them. 3. Attractions and repulsions, the grosser they are, govern the quantity of emigration and, as they rise in the scale, determine its quality. (1) The precious metals have been the loadstone of more immigrants than all other causes put together, and the attraction is independent of climate, distance, or accessibility. (2) The virgin soil of one colony, which yields eighty bushels of wheat to the acre, is a potent inducement to the solid agricultural class, while the infertile land and almost rainless skies of another have barred settlement. (3) The aspect and climate of Delaware were painted to the Scandinavian imagination as a "terrestrial Canaan," and this is still a stock-topic with emigration lecturers. (4) The savagery of the indigenes long checked emigration to North America and South Africa, and dispersed one New Zealand colony. (5) Leaders like Cortez and Rhodes draw crowds, and Puritan congregations followed their ministers across the Atlantic. (6) Cruel laws made Virginia unpopular in the eighteenth century, feudal exactions drove immigrants from New York, and the "peculiar institution" has at all times repelled them from the Southern States. (7) Personal, political, and religious liberties invite the best and the worst—Roger Williams and Hayraddin Maugrabin. (8) The prosperity of a colony and (9) the greatness of a country, like that achieved by the United States in

the War of 1812, constrain immigration. 4. Not accident, but deep affinities, have guided the northern Europeans to North America, Australasia, and South Africa, the southern Europeans to South America and North Africa. In these *officinæ gentium* new types will be generated by the fusion of allied varieties. And, finally, it may be that, in the primeval seats of mankind (if such there were), these new types will be themselves reblended into the one original race from which they sprang, but now immeasurably stronger, wiser, happier, and better.

Emigration is thus at first exclusively, and to the last predominantly, masculine in all its aspects. It is conducted by the heroic strand of humanity, the manlier races and their most vigorous sections; by these at the emergence of national manhood; by individuals of a strenuous type by the masculine classes and professions, aggressive religions, the male sex, and at the age of maturity; they are long actuated by the motives that govern the male animal; the earliest agencies are the spiritualization of the male mode of propagation, and the direction is at the beginning that of greatest attractiveness (as of a bride) and latterly the line of least resistance (as if toward a bridegroom). The feminine races, ranks, professions, sects, and sex—feminine elements along the whole sociological scale—join one by one in the fugue, and make at length of each colony a complete reproduction, yet with new attributes, of the mother country.

SECRETARY LANGLEY, of the Smithsonian Institution, reports that while the bison has been decreasing in the somewhat unfavorable locality of the Yellowstone Park, some increase has occurred in other parts of the country. A part of the great northern herd has been isolated near Ronan, Montana, and a remnant of the southern herd continues to be maintained in the Pan Handle of Texas. The secretary observes that Texas contains many animals that would be of advantage in our national zoölogical collection. Several of the Mexican species of deer range in this country, and many distinctively Mexican animals, such as the peccary and the jaguar, occur, while on the plains are found wild horses; and there are even a few camels running wild in some of the more inaccessible parts of the country, relics of a herd imported many years ago.

IN a paper on "Popularizing Astronomy," read at the eighth annual meeting of the Astronomical and Physical Society of Toronto, Mrs. George Craig dealt with the subject of establishing an observatory which would, under certain regulations, be open to the public, and be used for general observations of the beauties of the heavens rather than for special study of particular objects. She thought it would be comparatively easy to obtain money for such a purpose. Her scheme was considered decidedly opportune, and the society decided to take up the matter during 1898, and make special effort toward carrying it out.

THE AURORA.

By W. FARRAND FELCH.

"Low on the horizon, beyond Durdham Down, were streaks of white light, wavering spokes and flaring lines and streamers, flushing into faint rose pink. Could the buried sunlight still be felt so late into a night of May? Soon, by quiverings and motions in these signs—for the west darkened, and flames burst forth among the topmost stars, and toward the east ran swords, stealthily creeping across the heavenly spaces—I knew that this was an aurora borealis. The pageant rapidly developed, and culminated with dramatic vividness. At the very zenith, curving downward to the Great Bear, there shone a nebulous semicircle—phosphorescent, with stars tangled in it. From this crescent of light were effused to north and west and east rays, bands, foam-flakes, belts, spears, shafts of changeful hues, now rosy red, now brightening into amethyst, now green, now pale as ashes. The whole was in slow and solemn movement, like lightning congealed, which has not ceased to throb. As glaciers are to running water, so were these auroral flames to the quiverings of lightning. In the midst of all the glow and glory sparkled Ursa Major, calm and frosty. Other stars seemed to wander in the haze, as I have seen them in a comet's tail. The most wonderful point in the pageant was when the crescent flamed into intensely brilliant violet. Then it faded; the whole heaven for a few moments flushed with diffused rose; but the show was over. That supreme flash recalled the pulsing and rutilant coruscations with which Tintoretto spheres his celestial messengers. I could have fancied the crescent and its meteoric emanations to have been the shield of an archangel."—*In the Key of Blue, by* JOHN ADDINGTON SYMONDS.

I.

THE public was startled the other day by the announcement that Tesla had discovered a means and manner of telegraphing through space without wires, and that he had, by eight-foot flashes, so influenced the electricity of the earth that it would be felt all over the globe. This is an important discovery, if true—a revelation, now, that will be a revolution in the world of ideas. It may not be out of place to study these tremendous earth currents in their only visible form—the aurora. The subject certainly merits more than a transient treatment.

One of the latest issues of The International Scientific Series, which has now grown to seventy-five or eighty volumes, is entitled The Aurora, and is written by M. Alfred Angot, honorary meteorologist to the central meteorological office of France.

If one wishes an accurate account of the vicissitudes of starting and supporting this splendid series, and of educating the American public to receive and appreciate it, one has only to read John Fiske's admirable biography of the late E. L. Youmans, the pioneer of the movement not only in this country but abroad. To him are we thus indebted for an introduction to the works of Darwin, Huxley, Spencer, Tyndall, Bain, Balfour Stewart, Maudsley, Jevons, Lockyer, Quatrefages, Luys, Vignoli, Lubbock, Romanes, Ribot, and many others in this country; as the editor of the Popular Science Monthly

for years Mr. Youmans was entitled to no small commendation for his capable work; but, more than all, to greater credit for the good he has accomplished in this series than has ever been tendered him.

In the present work we have one of these inimitable special *brochures*, which appeals to a small circle of readers, but it proves none the less interesting for the general reader. The author begins with the history of the aurora borealis—so called in contradistinction to the aurora australis of the south pole—and cites mentions of it by Aristotle, Cicero, Pliny the naturalist, Seneca, and Gregory of Tours. It is shown by these writers to have been an object of superstitious

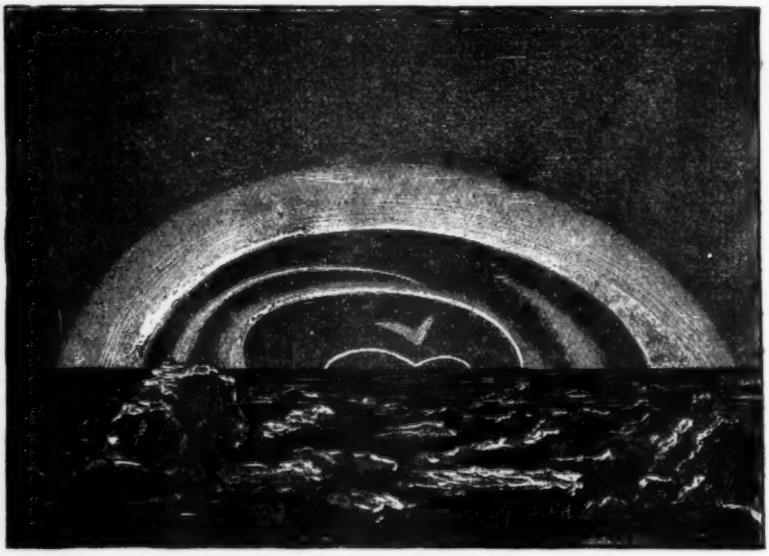

FIG. 1.—WINTERING OF THE "VEGA." ELLIPTICAL ARCS.

dread and terror, even down to the seventeenth century, no one being capable of understanding the nocturnal miracle then. For that matter, only the educated few understand it now. But it is no longer a dragon, a harbinger of woe, a pet terror for homilists and prophets, the Valkyrie of the Norse Eddas, nor a reflection of fire that surrounds the north pole or emanates from a polar cavity or from the interior of the earth at that point—which Nansen possibly just escaped, and Andrée is probably now experiencing! One Danish writer, who called it "the King's Mirror," and wrote a work with that title in 1250, thought the aurora was "produced by the ice which radiates at night the light which it has absorbed by day." Since 1621 it has been called aurora borealis by scientists, or in popular parlance "the northern lights" or "streamers." It is

"*nordlicht*" in German, "*nordljus*" in Swedish, and "*nordlys*" in Danish, all meaning northern lights.

The aurora in its most varied and interesting forms is either motionless or rapidly and incessantly scintillating. Of the first class there are three forms: (1) Faint lights without very defined form; (2) more distinct, in patches or clouds; (3) clearly defined arcs touching the horizon at either end. Of the second or moving class there are: (4) irregular arcs, formed of intermittent rays; (5) rays isolated from each other at a greater or less distance, converging to a fixed point in the sky, and sometimes forming around this center a crown or glory; (6) non-homogeneous bands, formed of rays pressed close together, which have not all the same degree of brilliancy; sometimes these bands fold over on themselves, becoming draped auroras, the most beautiful of their manifestations, aside from the boreal crown.

It sometimes happens that these arcs, instead of being circular, are distinctly elliptical; the two curves which form the upper and lower edge of the arc may or may not be parallel; sometimes, instead of a single circular arc, there are two, three, or four arcs, all perfectly concentric. Multiple striped arcs are not uncommon. Stars have been discerned through the rays, as also through the arcs, proving their extremely diaphanous character.

The chief characteristic of the auroral rays is their extreme variability. They are subject to two kinds of movements: the lateral or sidewise, and the longitudinal or upward; both movements are very rapid. A ray in twenty-seven seconds covered a distance of ninety degrees, or half the heaven, in one instance. At times a ray remaining nearly in the same place is seen at the upper extremity to dart toward the zenith or lengthen itself upward. At other times it rises and falls alternately, vibrating, and it is then said to dance. By sixteenth-century writers these rays were called "leaping goats" and "flying fires"; such rays are still known in Canada as "marionettes," and in the Shetlands as "merry dancers."

The direction of all the rays passes, as a rule, close to the magnetic zenith of the locality, or may radiate therefrom, as we have seen, forming a crown; the center of this crown may be either luminous or obscure. At certain moments the rays which compose this crown or glory enter into rapid movement, become very brilliant, and take on, instead of the usual yellowish-white color, vivid tints of red and green. This is one of the finest auroral effects, if not the finest. When one of these crowns forms in the midst of an already existing aurora, all the other lights of the aurora pale, to reappear when the crown is dissipated.

So much for the forms of the aurora. Now as to the colors. The

slow-moving forms are white, lined with yellow, milky and difficult to define. Rose carmine is the next most noticeable color. In the rapid-moving arcs, crowns, wreaths and draperies, the center is usually yellowish, one extremity red, the other green. The red is almost always toward the lower part and also in the direction to which the ray moves, while the green is above and behind. For instance, if a ray darts down from a crown, the lower end will be red, the upper green. These colors will be very brilliant; when the red is very brilliant, the green is as intense. The red remains longest and fades last, when fog obliterates the aurora finally.

Our author, it will be seen, is a close observer, and furnishes reasons for all his deductions. He has discovered that the brilliance

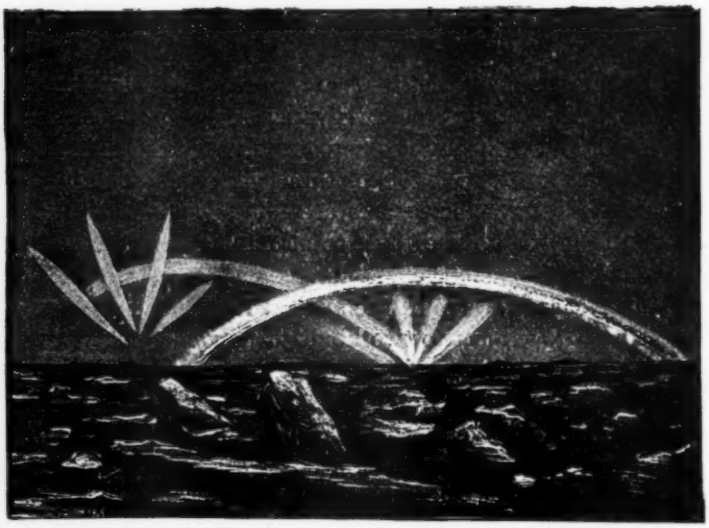

FIG. 2.—WINTERING OF THE "VEGA." MULTIPLE ARCS WITH DIFFERENT CENTERS.

of the colors bears a definite relation to the state of the atmosphere. In high latitudes, Sir John Franklin, McClintock, Weyprecht, and others aver that the coloring of the aurora was less strong when the air was very pure, and increased when it became foggy. The fine drapery forms are generally seen where seas are open in winter, free from ice, hence subject to fogs, as in Norway, Spitzbergen, and Newfoundland.

The light from auroras is very feeble; only a few lines of print can be read; while by the light of the full moon this is easy. The intensity of the aurora rarely exceeds the light of the moon in her first quarter, even in the arctic regions; this is corroborated by Parry, Kane, Hayes, Nordenskiold, and others. Auroras are less frequent in the full of the moon, paling in her effulgence, which drowns the

auroral display; but some of the brightest have been seen at full moon. Some have said that auroras could be seen in daylight, but this sounds like a ghost story.

It has been almost impossible to photograph the aurora, although in the winter of 1882–'83 a Swede at Spitzbergen claimed to have secured a faint image in eight minutes and a half. This was done before access was had to the orthochromatic plates, color screens, or lightning emulsions of to-day.

Some observers claim that the stars scintillate less when seen through an aurora; but this is caused, according to Montigny, by the presence of fog. On the contrary, it is clearly proved that the scintillation increases during any magnetic disturbance, even when the latter is not accompanied by an aurora.

As to the study of the nature of the light of an aurora there are two methods: by the polariscope and by the spectroscope. By the former it is easy to recognize whether it is a natural light emanating from a self-luminous body, or whether it reaches the eye after undergoing one or more refractions or reflections. Biot, in 1817, in the Shetlands, could not discover the smallest trace of polarization; this has been confirmed by Macquorn, Rankine, and Nordenskiold, and proves that the light of the aurora is not, like that of rainbows and halos, the result of reflection or refraction, but is itself luminous.

This important discovery is confirmed by the spectroscope. If the light emanating from a solid or liquid incandescent body is passed through the spectroscope, the resulting spectrum is continuous; if, on the contrary, the source of the light is gaseous, the spectrum is composed of a certain number of bright lines or stripes separated from each other by dark intervals. The number, the position, and the brilliancy of these bright lines depend upon the chemical constitution of the glowing gaseous body. The spectrum of the aurora was studied by Angstroem, in 1866, for the first time, and is essentially a spectrum of lines, hence gaseous by nature; it can not, therefore, be due to a reflection of the light of the sun, as has been supposed. The spectrum of the aurora runs the gamut from red to yellow, green, blue, and even violet, the last line of the spectrum having been seen but once, by Lemstroem in Lapland. Some of the lines are very similar in position to the spectrum of the electric spark or of lightning. The fourth line has not been found in any known body, and Angstroem attributes it to phosphorescence or fluorescence. For instance, oxygen is phosphorescent, and there is an abundance of ozone created by the aurora. A drop of sulphate of quinine has been made luminous by the action of the rays of the aurora, and so also has the double cyanide of platinum and potassium.

But, although we are getting nearer to the truth as to the nature

of the auroral light, it is not yet clearly known. There is also as much dispute as to whether any sound accompanies the aurora. The northern nations believe in the existence of this sound, like the rus-

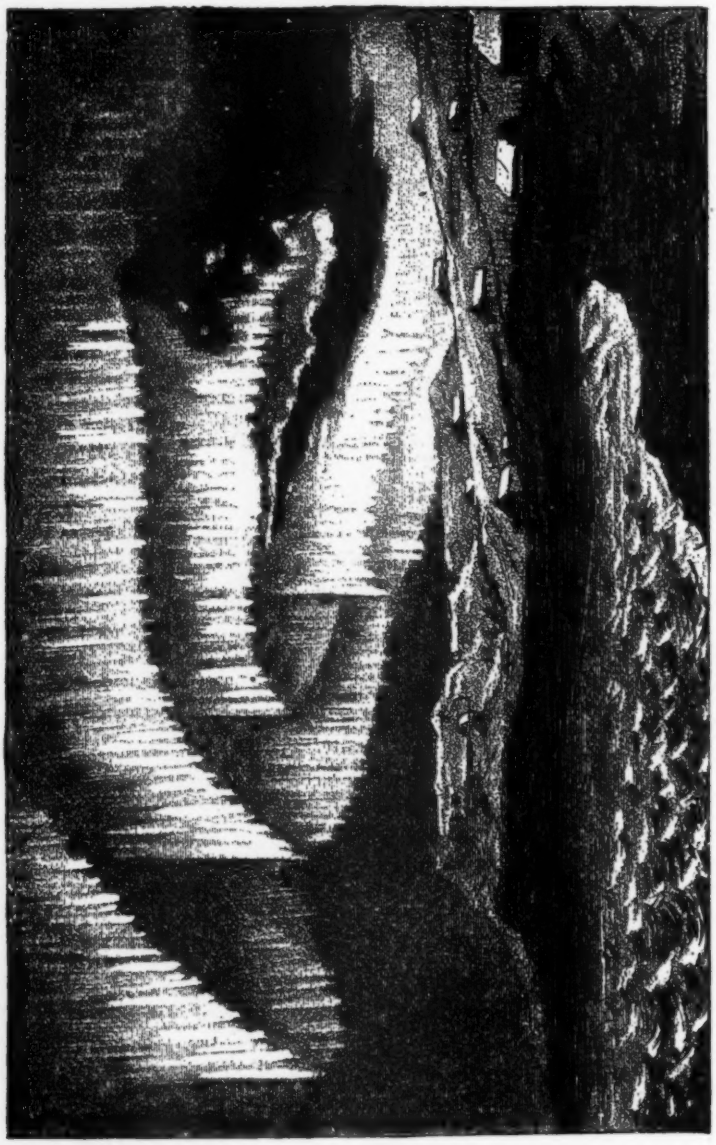

FIG. 3.—BOSSEKOP. DRAPED AURORA.

tling of silk or of straws, a "crackling" coinciding with the darting of the rays. This also is not well proved. In arctic regions it is probably confounded with the incessant crackling of fields of snow and the faint clicking of small needles of ice in the process of their

formation. In 1870, the aëronaut Rollier, escaping from besieged Paris in a balloon, landed in Norway, and he claims to have heard a persistent sound the whole time he was in a certain cloud, accompanied by a strong odor like ozone, very irritating to the bronchial tubes. A fine aurora was observed at precisely that time. Bergmann compared this odor to that of sulphur, and Trevelyan to that of electricity (?).

It is not necessary, at this juncture, to enter into a discussion of the extent, position, or periodicity of auroras, nor their relation to sun spots. But some new facts may be added that are valuable. There is a close resemblance between certain effects of the aurora and cirro-cumulus and cirro-stratus clouds, which are the highest clouds; so that it is difficult to tell whether a given effect is due to real auroral light or to these high clouds lit up by reflected light. Sometimes these bands of clouds stretch out in long parallel lines; again, they are due north and south and lie parallel to the needle of the compass, and are then called "polar bands." It has been discovered that when these polar bands occur during the day an aurora follows that night.

As long ago as 1580 and 1590, Tycho Brahe observed that the appearance of these polar bands and halos coincided with the presence of spots on the sun. Klein, in our own day, comparing twenty-five years of observations made with the greatest care at Cologne by Dr. Garthe, has confirmed the fact that these high cirrus clouds and polar bands follow as to their frequency the same laws as the spots on the sun; they succeed each other or even coexist. Many observers of the aurora are of the opinion that the appearance of the aurora depends on the presence of these clouds in the sky, which are in turn due to magnetic disturbances of the earth's photosphere originating in the sun spots. There are other evidences that the aurora is intimately connected with material particles in the atmosphere, like clouds and fog; for instance, when two or more rays in an aurora cross, the light is augmented, or when an aurora makes a fold on itself as in drapery forms, showing that there are two material "thicknesses" of the substance; moreover, the wind also acts on the aurora, which is torn after a tempest, showing that the wind has acted upon luminous clouds which are part of the aurora; finally, the presence of clouds seems to favor the formation and development of auroras. So there is an intimate relation between them.

II.

The rare phenomenon, St. Elmo's fire (balls of fire alighting on ship masts and spars), is frequent during auroras, but this is about the only form of electric disturbance of the atmosphere occurring

during auroras. Andrée, in 1882–'83, at Spitzbergen, with a Mascart electrometer, found that before an aurora appeared the positive electric potential of the air diminished rapidly, and even became negative, as usually happens when it rains; but as soon as the aurora appears the potential takes as before a high positive value. But it must be remembered that the electric potential of the atmosphere, especially at a short distance from the earth, varies constantly in an abrupt and irregular manner; so that it would be imprudent to assume any coincidence, even during an aurora.

Auroras seem to depend for their form and position in space on the distribution of magnetism on the surface of the globe. The appearances of auroras coincide in the majority of cases with magnetic disturbances on the earth's surface. The auroral arc generally has its summit near the magnetic meridian, where the compass needle points. The force which governs the auroras appears to be the same which the magnetic needle obeys. In general, the point where the rays converge in auroral crowns, the center of the crown, is near the magnetic zenith. The variation, in fact, in such instances is but one degree, which may be allowed as the amount of probable error in observations.

The conclusion is, therefore, that the earth's magnetic forces certainly play the most important part in the auroral display. The arcs or "bands" are nearly perpendicular to the magnetic meridian, and the direction of the rays parallel to the magnetic needle. The deviations from these rules are due to atmospheric conditions of temperature and humidity. The electric discharges which constitute the aurora borealis encounter all sorts of conditions of the atmospheric strata which are unequally conductive; hence lack of symmetry in the auroral displays. Meteorological conditions very likely influence not the production of the aurora, but its form and position. There is an intimate relation, as we have already pointed out, between the weather and these magnetic disturbances.

The magnetic needle sometimes begins to be agitated an hour before the appearance of an aurora. The magnetic disturbances last a long while, often for twenty-four hours. Motionless arcs and faint auroras do not affect the magnetic needle sensibly, while, during an active aurora, which is apparently nearer, the needle is greatly agitated, especially when the great red and green rays flash suddenly like lightning.

Arago has shown that if the aurora seems to be absent during magnetic disturbances, it is often because it is too distant, or below our horizon, and visible only in more northern latitudes. In the arctic and antarctic regions there is small deviation of the magnetic needle, but this is considered due to the great height of these auroras,

while local auroras are nearer the earth, of small extent, and due to local disturbances.

Telluric currents, passing along telegraphic wires, communicating with the earth at both ends, are visibly and often violently affected

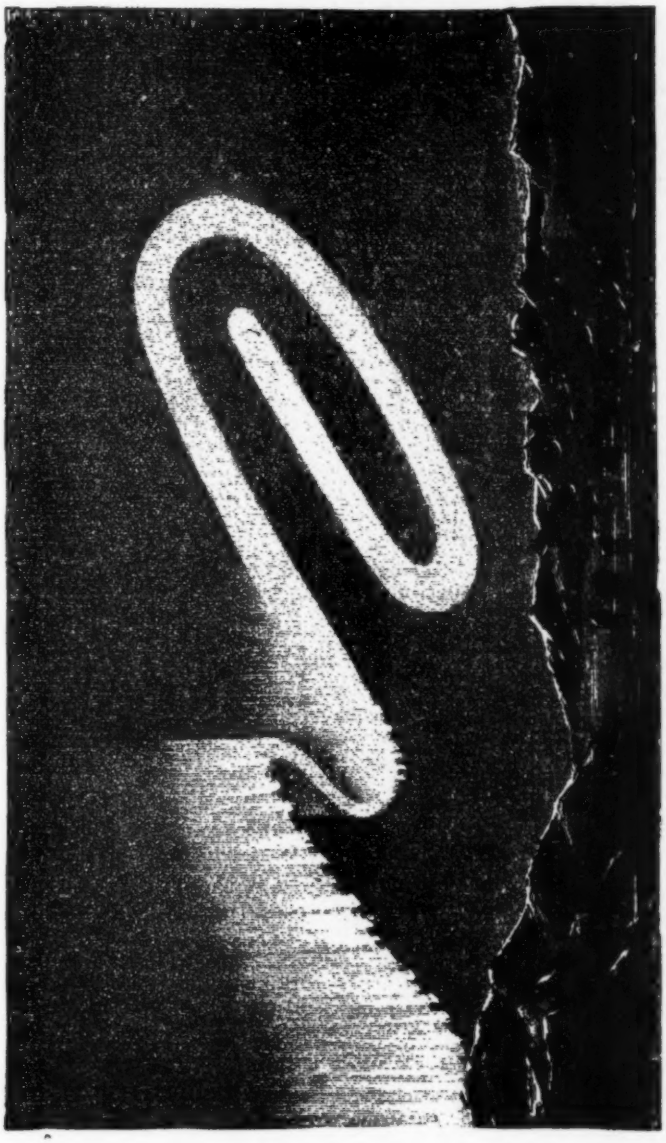

FIG. 4.—BOSSEKOP. DRAPED AURORA WITH HOOK.

during an aurora, setting electric call-bells ringing, preventing the transmission of messages by throwing the mechanism out of gear, and often proving a source of positive danger. This is not due to, or

during, a storm. The telluric currents cease when one end of the line is isolated; they are only manifested in single lines which have their return to the earth, but they may affect submarine cables, and they vary in direct ratio with the length of the line.

Balfour Stewart, in 1869, compared the earth to the center of a Ruhmkorff's coil, of which the circuit is completed in the higher strata of the atmosphere. Electric movements are hence produced in these higher strata when terrestrial magnetism or the telluric currents undergo rapid variations.

The aurora is supposed to be a purely terrestrial phenomenon, without regard to outside influences. The position of the earth in its orbit has no influence on the movements of the aurora. The movement of the earth from east to west is not the prevailing one of the aurora; the inverse movement is more frequent.

The magnetic theory of the aurora must now yield to the electric theory of its cause. We hope to show in a future paper the intimate relation of magnetism and electricity, but the subject is too vast at this juncture to examine. Halley, in 1716, thought the aurora due to luminous magnetic vapors, but electro-magnetism was then unknown. Dalton, in 1793, and Biot, in 1820, thought it was produced by ferruginous particles in the air, the dust of volcanoes, like that which caused the "red sunsets" several years ago from a volcanic eruption in Java. Van Baumhauer, in 1840, thought auroras due to the fall of cosmic dust, becoming incandescent when it entered the earth's atmosphere, as in the case of meteors and falling stars. Toeppler, as late as 1872, supported this idea, and even supposed the halo around the moon due to the same cause.

The electric theory seems destined to supersede the cosmic, optic, and magnetic theories. Canton, as early as 1753, pointed out the close analogy between auroras and the light of electric discharges produced in very rarefied air; he recognized also the fact that a tube of such air becomes luminous when moved about near a charged conducting body. In his view the aurora was but the form which storms take in polar regions. So far he was very nearly correct.

The ideas of Canton were adopted by Priestley, Eberhard, Frisi, Pontoppidan, Benjamin Franklin, and others, but without making much progress. A very similar opinion was adopted by Fischer in 1834, whose theory was that auroras were caused by electric discharges due to the positive electrization of the atmosphere; these discharges being produced at the moment when the electric equilibrium is re-established between the atmosphere and the earth, by the intermediary of particles of ice floating in the air. This was followed by the theories of Dove, de la Rive, Lemstroem, and others,

the latter producing on a Holtz machine electric discharges which electrified rarefied air in Geissler tubes.

Another theory, proposed a few years ago by Edlund, seems nearer the truth than any yet propounded. He began with the phenomena of unipolar induction, discovered by Weber. This is the name given to those currents which arise in each half of a metallic sheath which surrounds a magnet when the sheath is rapidly revolved around the magnet. It is known that the general phenomena of magnetism can be satisfactorily explained on the hypothesis that the earth is a magnet with two poles. The earth rotating on its axis is similar to the sheath, and unipolar action is induced.

Edlund shows that a molecule charged with positive electricity, taken on the surface of the earth, is subjected to two forces: one, from below, driving it upward into the air; the other force, perpendicular to the first, drawing it toward the nearest pole. The first movement is in full force at the equator and nil at the poles; the other is nil at the equator, increases with the latitude, and is again nil at the poles. The tendency is then for the electrified molecule to rise in the atmosphere, thereby accumulating a store of electricity in the higher atmosphere, the movements thence tending toward the poles. As rarefied air and gases are good conductors, being like a vacuum, the electricity will find little resistance at the poles, in returning to the earth. It can either return in disruptive discharges like storms, or in slow discharges in the form of continuous currents, as in the polar aurora. The vertical force is here nil. The electricity of the atmosphere generally re-enters the earth before it reaches the poles, producing local auroras. In polar regions the tension or attraction is much stronger, the flow downward more rapid, having only to overcome the resistance of the air, hence producing greater displays.

Edlund's theory satisfactorily accounts for (1) the direction of the rays of the aurora; (2) the frequency of auroral crowns; (3) the zone of greatest frequency being in polar regions; (4) the deviation of the summit of the auroral arcs from the magnetic meridian (which does not coincide with the geographical meridian); (5) the accidental deviations caused by atmospheric conditions, clouds, humidity, and temperature, that cause curtains, draperies, cirrus effects, etc. This theory seems of all others the most tenable and credible, and should be retained, at any rate for the present, until a more plausible and satisfactory one can scientifically be adopted. It explains clearly the occurrence of polar auroras which are simple, and less reasonably the auroras of immense extent covering two thirds of the globe. These are always accompanied, as we have seen, by marked magnetic disturbance and telluric phenomena, which are probably

more active as causes than the Edlund currents. It is natural to suppose that any variation of the earth's electrical equilibrium or potential would tend to draw down the atmospheric currents. Here would come in the action of the electrical currents which coincide

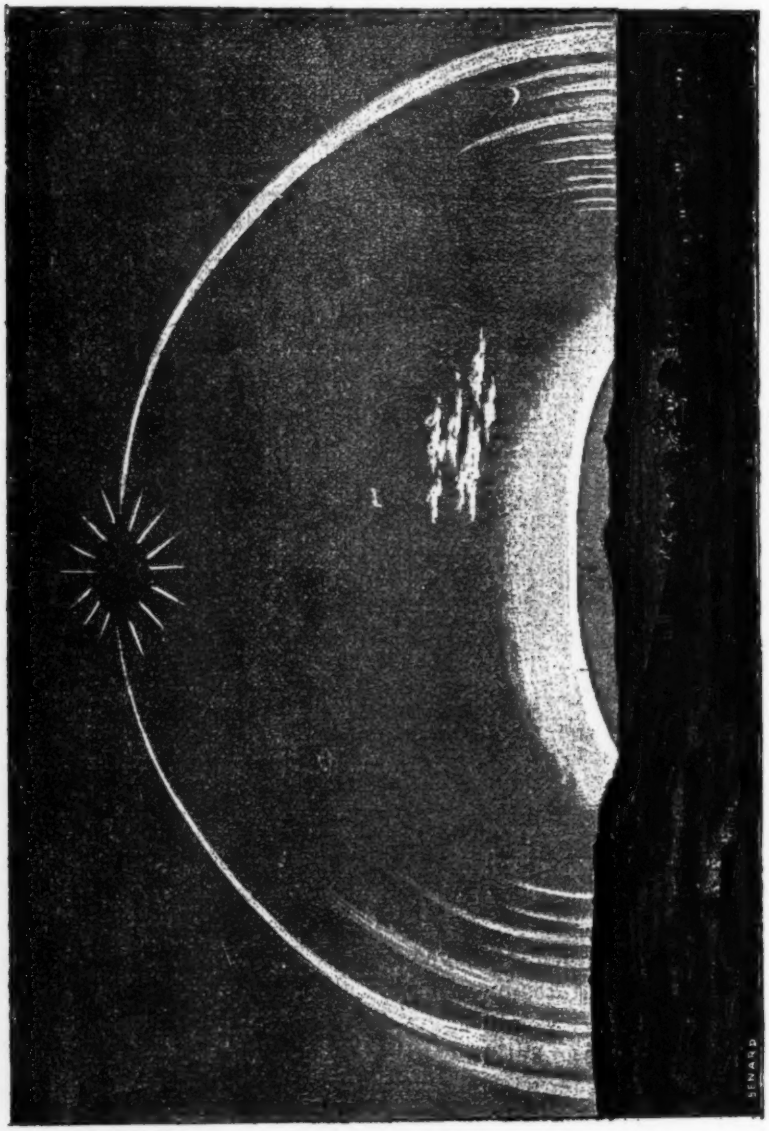

FIG. 5.—MELBOURNE. AURORA WITH ARCS AND CORONA AUSTRALIS.

with sun spots, and which undoubtedly produce electric storms in summer and auroras in winter. Magnetic disturbances and telluric currents have a known relation to sun spots; so also must the aurora in its secondary widespread form.

This theory accounts for nearly all the points on which there is now any uncertainty. There only remains the spectroscopic side of the subject, as intimated, to account for all the lines in the spectrum of the aurora. The yellowish-green line (the fourth in the spectrum) to which we have referred is only found in the "zodiacal light" which travels along the zodiac at certain times of our year. But while there is otherwise no identity between the two forms of light, this would indicate an intrastellar or supermundane source of both lights. So it is very probable that cosmic causes, foreign to our globe, may determine on our globe the production of the aurora. We have dwelt in other papers on the influence of the sun spots, so it is not necessary to revert to them, except to confirm our previous theory and impressions. These phenomena all appear to obey the successive phases of solar activity, and the electric theory of the aurora fully accounts for their relation to each other. If sun spots can cause a widespread action of the aurora in polar regions, why can they not induce magnetic disturbances, electric storms, and all the fury of tempests in temperate regions, acting along exactly the same lines of current, only deflected sooner to the earth than the rays of force which reach the earth nearer the poles? It is a very simple question, and the answer self-evident.

Laboratory study of electric discharges in rarefied air and gases has not yet reached a point where the spectrum of the aurora borealis can be artificially produced. A study of the zodiacal light, and of the influence of magnetism on light, will be necessary to reveal this factor of the problem. This opens an immense field of further research in which scientists must still delve.

In the Baram district of Borneo, according to Mr. C. Hose, it is customary, when a dispute arises, concerning the ownership of a fruit tree, for example, for the parties to take their positions, in the presence of the witnesses and a throng of spectators, in about four feet of water, each asseverating that he is the rightful owner, and praying that the water and the birds and animals may bear him witness. Two sets of cross-sticks have been driven into the mud at the bottom of the river. At a given signal, each disputant puts his head under his cross-stick and keeps it in the water as long as he can, a friend holding his legs in order to detect the first signs of fainting and pull him out on their appearance. The man who can keep his head under water the longer time is declared to be the winner, and the loser is not allowed to make any further claim. Men recovering from serious illness often change their names, hoping that the evil spirit that caused their illness may lose trace of them. When this is done, the former name is never mentioned again. The most precious articles of clothing and weapons are deposited in the graves, because the friends wish the spirit of the deceased to appear to advantage on his arrival in the other world.

TOPOGRAPHIC FEATURES DUE TO LANDSLIDES.*

By ISRAEL C. RUSSELL.

IT is well known that masses of rock sometimes break away from steep slopes and descend as avalanches or landslides into adjacent depressions.

The topography of a region where landslides occur is changed in two ways—i. e., by the removal and by the accumulation of material. The contours of a mountain, plateau, or other land form that stands in relief, are altered by the removal of material; as, for example, when a portion of the border of a plateau falls away, a re-entering angle or curve is produced; or, when a rock avalanche occurs on a mountain side, a high-grade gorge or depression may result. The material composing a landslide comes to rest in ridges and piles which have certain characteristic shapes. The most noticeable feature in such instances is the backward slope of the surface of the displaced material after it comes to rest. The surface of a landslide, whether composed mainly of a single block or of a heterogeneous mass of loose material, slopes toward the cliff from which it came. This backward slope tends to the formation of basins in which water accumulates, and lakes and swamps result. The backward slope referred to appears to be due to friction between the moving mass and the rocks beneath, which retards the progress of the material at the bottom and in front, so as to allow the material which comes later and at a higher level to slide over it. In a heterogeneous mass of fallen rocks there appear to be several planes of shear along which differential motion has taken place.

The changes produced by landslides are usually considered, even by geologists, I believe, as of a local character and of minor importance in the topography of most regions. Recent studies by the writer of the geography of the lava-covered region of Oregon, Washington, and Idaho, however, have shown that the phenomena referred to furnish an explanation of the origin of a class of topographic forms which occur not only on mountain sides and plateau margins, and among the hills at the bases of such elevations, but in certain instances in the minor features of broad and approximately level plains.

The landslides or avalanches which sometimes rush down the sides of mountains are frequently, and probably in most instances, composed of loose rock and soil. The most frequent condition leading to such catastrophes is the saturation of the material with water. Landslides usually follow heavy rains. The famous Willey land-

* Published by permission of the Director of the United States Geological Survey.

slide in the White Mountains in 1826, and the still greater one which descended into Biraki Ganga River, near Gohna, India, in 1893, and gave origin to Gohna Lake, are instances of this nature. A large number of landslides, however, are due to geological rather than climatic causes, and it is to this class that I wish to invite attention.

It frequently happens that a layer of hard rock rests on softer or more easily soluble beds. When steep escarpments are formed of two strata having this arrangement, conditions are produced which favor the breaking off of masses of the hard upper layer and their descent to the foot of the escarpment in landslides. There are other conditions, such as the thickness of the hard layers and the manner in which they are jointed, and the consistence of the soft beds—whether slippery clays, loose volcanic *lapilli*, etc.—which modify the process. The main or controlling conditions referred to are furnished at hundreds of localities in the region occupied by what is known as the Columbia lava, and drained by Columbia River. In that region sheets of basalt, ranging from two to five hundred feet and more in thickness, alternate with or overlie sheets of clay, shale, volcanic tuff, etc., which in many instances are hundreds of feet thick. The basalt was poured out in a molten condition and spread over the land in horizontal sheets. On cooling, these sheets acquired a columnar structure due to joints, usually at right angles to the top and bottom surfaces. This columnar structure facilitated the breaking away of great masses of basalt, when, for various reasons, portions of the sheets form the summits of bold escarpment.

In part, the Columbia lava, and the softer beds interleaved with it, have remained undisturbed, and are now practically horizontal over thousands of square miles. In adjacent areas of a great extent the beds have been broken by extensive fractures and the blocks thus formed variously tilted. Over still other extensive regions, particularly in the Cascade Mountains, the originally horizontal sheets, aggregating several thousand feet in thickness, have been raised into dome-shaped uplifts, at least one of which is nearly circular, while others are more nearly elliptical, the major being several times as long as the minor axis. Some of these domes, if unaffected by erosion, would have an altitude above their immediate bases of from five to eight thousand feet.

Where the Columbia lava is still essentially horizontal, as in southeastern Washington, it has been dissected by streams which now flow in magnificent cañons with clifflike walls from a thousand to four thousand feet high. In the region referred to as having been extensively fractured, cliffs have been produced by the tilting of the blocks thus produced. The dome-shaped uplifts have been broken by weathering and by the work of streams in such a manner as to

remove their more elevated portions, and leave their truncated bases as a series of cliffs facing inward toward the center of the uplift. Thus, in many ways, and owing to still other conditions noted in part below, the region of the Columbia lava has become a land of great escarpments.

The fact that the escarpments referred to are formed of the edges of layers of hard basalt, which are traversed by joints at right angles to the planes of bedding, and also the occurrence of layers of soft rocks beneath the hard, cliff-forming layers, furnish conditions unusually favorable for landslides. In fact, *landslide topography*, as it may be termed, is nearly as characteristic of the Columbia lava region as are its magnificent cliffs. The topographic features due directly to landslides themselves are probably seldom recognized, while the long lines of frowning escarpments obtrude themselves on the attention of even the least observant. The fact is, however, that the cliffs in many instances have resulted from the breaking away of large rock masses, and will in time be destroyed by the same process.

The alternation of lava sheets and of lacustral sediments, etc., is not a marked feature of the entire country occupied by the Columbia lava, and for this reasan great variations occur in the extent to which the escarpments of that region have been affected by landslides. In southeastern Washington, for instance, sedimentary or other soft layers between the lava sheets are relatively unimportant, and throughout scores and even hundreds of miles of cañon walls appear to be absent. In this portion of the field the evidences of former landslides have not been noted.

In striking contrast with the region just referred to is the great dome from which the Wenatchee Mountains have been sculptured. (The Wenatchee Mountains are situated in the central portion of Washington, and on the eastern flank of the still vaster and much elongated Cascade dome. Mount Stuart and a number of associated peaks composed of dense granite form the center of the Wenatchee dome, and now stand in bold relief, owing to the removal of softer beds from about them.) In this instance the central portion of a dome fully fifty miles in diameter, has been removed and the truncated edges of the hard layers composing it left in prominent escarpments which sweep about the central core of granite in vast irregular curves. At least four sheets of Columbia lava, varying in thickness from three to four or five hundred feet, formerly extended over a large portion and possibly covered the entire region where the Wenatchee dome was upraised, but have been eroded away from its central portion. The uncovering of the region referred to, embracing fully one thousand square miles, has been accomplished by

the slow recession of inward-facing cliffs, due principally to their having fallen from time to time in landslides, and the gradual decay and removal of the fallen blocks by streams and percolating waters. This process is till in progress, and a series of topographic changes from fresh landslides to rolling, prairielike lands with deep, rich soils and features characteristic of old land surfaces, can be easily traced. The reader must not infer, however, that the entire area from which the successive sheets of Columbia lava have been removed has a low relief. The streams have cut deeply into the rocks beneath the lowest lava sheet, and produced a markedly different series of land forms, in which sharp ridges and deep, narrow valleys are conspicuous elements. A belt of country marked by landslide topography which was gradually smoothed out, owing to the decay and erosion of the fallen blocks of basalt, receded with the slow retreat of the encircling cliffs and was replaced by exceedingly rugged topography.

The nature of the changes produced by landslides and the subsequent decay of the fallen masses and their melting down, as it were, into an undulating plain with undrained basins, is graphically displayed at many localities adjacent to the still receding escarpments. Favorable localities for this study are furnished by Table and Lookout Mountain, to the northward of Ellensburg, Washington, or on the southeastern margin of the truncated Wenatchee dome. Standing on Lookout Mountain, for instance, one beholds toward the southeast a gently sloping table-land which rises toward his station. The surface of this inclined table is formed of a sheet of Columbia lava, but not the older sheet, which dips southeast at an angle of four or five degrees. On its northwestern margin this table-land breaks off so as to form a precipice from a thousand to twelve hundred feet high. In many places this escarpment is vertical, but its lower slopes are masked by talus. Below this palisadelike escarpment are many others of a similar character, but of less height and seldom over half a mile in length. The lower escarpments are formed of the edges of blocks of lava which have broken away from the main escarpment from time to time and plowed their way down into the valley. The fallen blocks are inclined at angles of ten to fifteen degrees toward the cliffs from which they fell. At the base of the main escarpment there is a series of irregular depressions or basins, which connect one with another more or less perfectly, and are bounded on their northwest margins by the backward-sloping blocks. In three of these basins at the present time there are small lakes without visible outlets. Each lake is four or five acres in area, and, except where the basins have become partially filled with talus from the overshadowing cliffs to the eastward, are deepest on that side. The western edges of the fallen blocks rise some two or three hun-

FIG. 1.—CABIN LAKE AT THE WEST BASE OF LOOKOUT MOUNTAIN; AN EXAMPLE OF A LAKE OCCUPYING A LANDSLIDE BASIN.

dred feet above the surfaces of the lakes, situated on their depressed borders. A view of one of these interesting lakes is given in Fig. 1.

To the northwest of the basins holding lakes, just referred to, there is a series of ridges and hills inclosing undrained basins, which extends about two miles from the base of the main escarpment and gradually decreases in height at the same time that the minor features in their relief become more and more subdued. This belt of ridges and basins finally merges by insensible gradations into a tract of undulating, prairielike land, two to three miles broad. The edges of the more recent of the fallen blocks stand out as sharp-crested ridges, with gentle slopes toward the great cliffs from which they fell, but present precipitous escarpments of bare rock toward the valley. As one descends the series of ridges and hills, the cliffs become less and less sharply defined and soon give place to rounded swells. Old lake basins change to swampy areas, and at a still greater distance become grassy dells.

As already stated, there is a gradual transition from the still hilly region to the undulating plain, at the northwest base of Lookout Mountain, where the relief has been smoothed out and only gentle, flowing outlines attract the eye. On the margin of the plain adjacent to the lower hills there are obscure ridges, on which there are many rounded and much-weathered bowlders of basalt, but a mile farther westward the soil is exceedingly fine and homogeneous, and scarcely a stone can be found. Such pebbles as do occur are of basalt, rounded by decay. A characteristic feature of the plain, now cleared of the scattered groves of pine that formerly covered it, and sown with wheat, is the presence of shallow, undrained basins, with low, gently swelling hills between them. This tract of country, eight or ten square miles in area, lies between Teanaway River and Swank Creek, but is entirely without stream channels. The scanty rain is absorbed by the deep, porous soil.

The undulating, prairielike lands just described have resulted from the slow disintegration and decay of blocks of basalt which fell as landslides during the slow recession of the thick lava sheet and of the soft volcanic tuff beneath, which once covered the region. The undulating surface of the wheat lands, with undrained basins, illustrates the old age of landslide topography. A view of this undulating plain is reproduced in Fig. 2. The hills seen in the distance owe their origin to another sheet of Columbia lava, the lowest of the series, which slopes toward the observer, and breaks off in steep slopes to the northward.

An ideal section through the margin of Lookout Mountain is

FIG. 2.—UPLANDS TO THE WEST OF LOOKOUT MOUNTAIN, WASHINGTON, ILLUSTRATING OLD LANDSLIDE TOPOGRAPHY.

shown below. The section crosses one of the lake basins at the base of the mountain, and is continued northwestward through the belt of hills and basins to the plain into which they merge. In this diagram an attempt has been made to indicate the breaking down and rounding of the fallen blocks, and their gradual change to an undulating plain.

In some instances a landslide plows its way out into a valley for a mile or more from the base of the cliffs from which it came, and

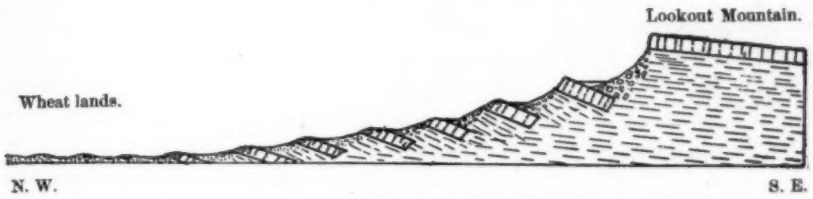

FIG. 3.—IDEAL SECTION THROUGH LOOKOUT MOUNTAIN, WASHINGTON, SHOWING LANDSLIDES.

forces up a series of ridges and mounds about its margin. These ridges have a striking resemblance to terminal moraines left by the recession of glaciers, but the scars on the adjacent escarpment or mountain sides and the associated hills and basins plainly show their origin.

The sequence of topographic changes described above, so well illustrated at Lookout Mountain, is typically and characteristically displayed at hundreds of other localities in the same general region, but is not confined to the basin of the Columbia. With minor modifications due to local conditions, it may be recognized in many lands where bold escarpments occur. Where a humid climate prevails, however, and streams occupy the valleys, the old age of landslide topography is seldom reached.

The Columbia lava, it will be remembered, was spread out during a series of inundations of molten rock and has an area of approximately two hundred and fifty thousand square miles. Previous to the opening of the tens of thousands of fissures through which the molten rock reached the surface, the country had a rugged topography due to erosion. The lava covered the plains and entered the valleys in the mountains so as to give them level floors. Hills, ridges, and mountains were in some instances partially or wholly surrounded by the fiery flood and became capes and islands. Isolated eminences of the old land rise through the sheets of lava which cooled and hardened about them, in much the same manner that *nunatakas* break the monotony of the borders of the Greenland ice fields. When these islands in the sea of lava are of resistant rocks, like quartzite, which withstand the attacks of the destructive agencies of the air better

than the encircling basalt, they still remain in bold relief, as is illustrated by Steptoe and Kamiack buttes, described elsewhere by the present writer.*

When, however, the projecting portions of the nearly submerged peaks and ridges were of granite, volcanic tuff, limestone, etc., which weather more rapidly than the surrounding lava, they have wasted away so as to give origin to basins, valleys, and cañons, with boundary walls of basalt. The sheets of basalt in these escarpments in many instances rest on less resistant rocks, and a recession of the cliffs due to the breaking away and falling of large masses of their capping layers takes place. The fallen blocks disintegrate and waste away in the manner described above, and the cañons and valleys increase in size. The ground plans of the depressions originating and enlarging in this manner, vary according to the shapes of the islandlike rock masses which have been removed; some of the depressions are nearly circular, others are greatly elongated, and now have the characteristics of flat-bottomed cañons with vertical walls.

The remarkable circular valley surrounded by an almost continuous palisade in eastern Oregon, known as Grande Ronde Valley, from which a river of the same name flows northward to join the Snake, is an illustration of the class of topographic forms produced in the manner described above. I can not testify from personal observation as to the nature of the soft rocks beneath the lava in the walls of Grande Ronde Valley, but other similar valleys, less regular in outline, near at hand, have resulted from the removal of islandlike masses of soft volcanic tuff.

Another unique feature in the topography of the region drained by the Columbia is the Grande Coulée in what is known as the Great Plain of the Columbia, or more familiarly as the "Big Bend country," in central Washington.. The Grande Coulée is a flat-bottomed cañon some thirty miles long and varying in width from two to four miles. In its vertical walls, usually about three hundred and fifty feet high, the edges of several sheets of Columbia lava are exposed. This great trench through the but little disturbed plain of lava was in existence previous to the Glacial epoch, and furnished an avenue of escape for Columbia River which was dammed by a glacier. At the southern end of the Grande Coulée, as can be seen from Coulée City, the lava sheets on its eastern side dip gently eastward, while the beds comprising its western wall are apparently horizontal. This fact led me to infer that the Grande Coulée, like several other similar but smaller cañons in the lava, is due to stream erosion along a line of

* A Reconnoissance in Southeastern Washington. Water Supply and Irrigation Papers of the United States Geological Survey, No. 4, 1897, pp. 37–40.

fracture.* At the northern end of the cañon, however, granitic rocks form a portion of its walls, and stand as isolated towerlike masses within it. Some of these towers are capped with horizontal lava sheets. When the lava was poured out it surrounded a granite ridge having the position of the Grande Coulée, but probably not extending as far south as the depression since formed. The weathering and removal of the granite gave origin to a trenchlike depression with vertical walls, composed of basalt above and granite below. The more rapid crumbling of the granite led to the breaking away of the jointed basalt resting on it, and the widening of the depression in the manner already noticed.

From the brief and inadequate description I have given of certain of the more striking features of Washington and Oregon it will be seen that landslides have modified the topography of the region occupied by the Columbia lava in several ways. There are yet other changes in the geography of that most interesting and instructive land due to the same causes. Chief among them are the obstructions to the streams formed by landslides, and the production of lakes and rapids. At several localities in the upper Columbia masses of rock which have fallen from the cliffs bordering the stream obstruct its course. There are now no lakes along the course of the river due to this cause, but terraces above rocky rapids, show where such water bodies previously existed.

Perhaps the most interesting fact brought out by the study of landslide topography is that certain broad, nearly level areas, now covered with deep, rich soil, and in the autumn golden with the sheen of ripened grain, owe the minor features in their relief to ancient landslides. The hills, with broadly rounded summits, and the shallow undrained basins between, in such regions are an inheritance from a time when long, precipitous escarpments, by their slow recession, left the land covered with a rugged, confused mass of fallen blocks. A review of the facts concerning the minor features in the relief of the broad wheat lands of southeastern Washington,† in the light of the conclusions here presented, leads to the suggestion that some of the ridges and basins of that region may be due to the recession of cliffs produced by stream erosion. Many portions of the deeply decayed surface of the basaltic plateau of southeastern Washington resemble closely the old landslide topography in the valley to the northwest of Lookout Mountain, shown in the accompanying illustration.

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* A Geological Reconnoissance in Central Washington. By Israel C. Russell. United States Geological Survey Bulletin, No. 108, 1893, pp. 90–92.

† A Reconnoissance in Southeastern Washington. By Israel C. Russell. Water Supply and Irrigation Papers of the United States Geological Survey, No. 4, 1887, pp. 58–69.

THE PHILOSOPHY OF MANUAL TRAINING.

By C. HANFORD HENDERSON,
LECTURER IN HARVARD UNIVERSITY.

III.—THE MANUAL TRAINING SCHOOL.

THE educational sequence in America is not yet an established order. The amount of schooling that a boy or girl is supposed to need is not the same in the Carolinas that it is in Massachusetts. In the more highly evolved communities the pressure is all in the direction of an elaborate educational process. The gap between the minimum and the maximum requirements is very great. It would be unfortunate, however, to believe that virtue lies at either extreme. It is quite possible to have an educational process so meager as to be utterly inadequate to the needs of modern evolved living. And this extreme is apt to be found in communities where either Nature is too bountiful in her offer of a living, or where the invitations to action are too strong to be resisted. It is difficult to imagine the educational process as too comprehensive in Florida and Louisiana, or at the present time in gold-smitten Alaska. But it is also quite possible for the educational process to be so elaborate, so exacting, so time-consuming, that it takes the juice quite out of life, and gives us weakness instead of strength. The friends of action have, I think, quite as just cause for complaint in the devitalized and unattractive specimens of manhood and womanhood that the schoolmen are apt to send them, as the friends of thought have in the crude and ignorant youth who turn out of a holiday.

It is impossible to overeducate, but it is very possible to overschool.

In my own experience I have found that I could accomplish more with the boys who had been least in school. I have had boys graduate at a high school whom I could not induce to take a college course. They had been under instruction eleven long years—for remember that in childhood the years *are* long—and they were simply tired out. I could not blame them for wanting a change, though I did feel very strongly that they had put in their time at the wrong end of the sequence, and were giving up the far better part. And I have talked with clever young fellows in high school and college and have asked them if they could remember anything useful that they learned below the high-school grade. They have replied that they could not, or else they have mentioned something so trivial that when balanced against six or eight years of human life it seemed absolutely pitiful. I should be sorry to use a false standard in estimating the value of these schools. Their work is to be judged not by the

specific useful facts that the children remember in after years, but by the general influence upon their lives. You perhaps remember that incident of Garfield. He relates that he once heard Emerson lecture, and that it was for him the beginning of a new life. Yet all he could remember of the lecture was one of those bullet sentences of Emerson's—"Men are as lazy as they dare to be." It is quite possible to fire the imagination of men and women, and have them clean forget whether it was by an electric spark or a tallow candle—or neither.

But when we look at our educational structure, and note what tremendously extended foundations it has, what an almost unending vista is presented by the lower schools, and then see how palpably it shrinks in rising upward to the high school and college, what a very low pyramid it forms after all, I can not but feel that the influence of these schools in arousing children to the higher life has been quite as weak as has been their informational capacity.

I do feel that in failing to impart abounding life and health, in failing to arouse a keen interest in the many beautiful sides of life, these schools are partly responsible for the apathy and *ennui* that you read in the faces of middle-age and middle-class America.

The wise sequence does not lie at either extreme—either seven weeks a year for three or four years, or ten months a year for a score or more of years. The present sequence in our older communities runs somewhat as follows: the kindergarten up to six years; the elementary school for about eight years; the high school, four years; the college, four years; the graduate, technical, or professional course, from three to six years. The educational process begins with very tender baby flesh, and ends with pretty solid men and women. It is not one day too long if it lead irresistibly to the radiant life. It is many years too long if it lead to ill health, to apathy, to hopelessness, if it lead to loss of initiatory power, to pedantry, to conventionality, to cowardice. It is a question of the *quality* of the results. Even this elaborate process, however, is not yet correlated and continuous. The lower schools and the high schools have been brought into pretty close relations, since both are commonly under public administration, but even here, in many of our cities, a remnant of the old apartness remains in the entrance examination to which the children are obliged to submit at the doors of the high school. Curiously, the public administration is not willing to accept its own stamp of approval or blame as set by the lower schools. But between the high schools and the colleges there is a very noticeable gap. The two are under different administrations, and in our less enlightened communities they are not infrequently antagonistic. There are now, however, associations throughout the

country that have for their express purpose the bringing about of a more complete understanding between the high schools and the colleges, and the mutual adjustment of the curriculum of the high school and the entrance requirement of the college. It is more and more coming to be felt that the best education should be the one leading to college and should be the one for all.

Now, into this somewhat vexed state of affairs the manual training school has come and must be given due place, and brought into relation with the rest. Coming as it did with its technical side uppermost, it was decided at once to be too strong meat for babes and was graded as a high school. This determined its relation to the lower schools, and there was no difficulty on that score. The children from the lower schools pass the same entrance examinations, whether they elect the manual training or the English or Latin high school. In some of our cities, and notably in those of the middle West, manual training has been incorporated into the regular high schools, and consequently has introduced no new problems, at least as far as the educational sequence is concerned. But the older typical manual training school is a distinct instituion, one of recognized high-school grade, but differing from the older high schools in having a three years' course in place of four years.

If I have at all succeeded in making clear to you the philosophy and methods of manual training, you will easily see that as a scheme of education manual training is equally applicable to all grades, the lowest as well as the highest. It is only that the work would have to be adapted to the age of the children. We should not expect babies to make steam engines any more than we should expect them to learn to read out of Shakespeare. From the artisan point of view it is limited to the upper grades, for little children can scarcely gain enough industrial skill to make it worth while. There are, however, only a few elementary manual training schools in this country. There is a public one in Philadelphia in the slum district, and there are several conducted by charitable organizations there and in New York and other cities. It is most encouraging to note, however, that manual training is rapidly making its way into the regular elementary schools. In New York city alone two hundred thousand children in the lower schools are having manual training, and it is making its way into nearly every progressive grammar school in the larger cities either as a required or elective study. But in the main, when we speak of a manual training school, we mean a high school having a three years' course, and it is to such a school that I want to call attention in this paper. Furthermore, I am sorry to say, a typical manual training school of the older sort means a school for boys only. But with the growth of the educational idea, manual train-

ing is rapidly being extended to the girls too. In the West they are much ahead of us in this respect. In Denver, for example, they have a fine manual training high school, with a very liberal course of study, and open, as it should be, to both girls and boys. In Kansas City, the new Manual Training High School has just opened with an initial enrollment of seven hundred and thirty-six children—three hundred and forty-nine boys and three hundred and eighty-seven girls. In San Francisco, the Polytechnic High School is open to boys and girls alike. And this represents the general spirit throughout the West. I am very glad to see it, and I am the more sorry that our older and representative manual training schools in Baltimore, Philadelphia, St. Louis, Chicago, Brooklyn, and Boston do not unlock their doors to girls in the same open-minded fashion.

The material that comes to a manual training school has always interested me. It does not come from any one class in society. On the contrary, it is a very composite group. News of the movement naturally reached the most advanced people of the community first. In the early days in Philadelphia—that is, something over a decade ago—it seemed to me that nearly all the boys in the training school were unusual. Their parents for the most part were come-outers of some sort, liberals, people interested in social and religious reform, very wide-awake people. As time went on, the groups became less marked. The industrial side of manual training got noised abroad, and for a time many boys were sent to the school merely because they were not fond of study, and the school was mistaken as a place for busy hands and sluggish brains. Boss mechanics, with no great faith in education, but with a strong desire to have their sons get on in the world, compromised the matter and sent them to the training school. From the very start, too, there was a large influx of Jewish children, whose parents were actuated, I think, not so much by that text in the Talmud which bids every man have a trade, as by the broader feeling that the children of Israel as a people were suffering from their too long and too exclusive devotion to commerce. The Jewish charitable organizations have since established a number of free manual training schools in the different cities, and are especially working among the poorer Russian Jews. There were also a number of colored boys, but these seldom remained to graduate.

Now that the schools are better known, and have taken their place alongside of the regular high schools, the choice has largely passed from the parents to the boys themselves. They come to the training schools, sometimes for good and sufficient reasons, because they have a taste along mechanical and scientific lines rather than linguistic lines, but often the reason is quite capricious. They come because some chum of theirs happens to come, or they don't come

because some girl friend sticks up her nose at the dirt and the aprons, and calls the boys mechanics. And I should like to say in passing that I think we do not sufficiently realize the importance of having girls entertain high ideals of boyhood, and boys entertain high ideals of girlhood, for sooner or later each sex is bound to be what the other sex wants it to be. When I hear men running down women, or women running down men, I always feel very sorry, but I feel disposed to say: My friend, this may be so, but if so, it is partly your fault.

The average age of this composite group I should place at something over fourteen. The boys may enter at thirteen, and I am told that in New England they commonly do so, but the work as at present arranged is better suited to older boys.

The curriculum is divided into five departments:

1. The Humanistic, or Language Group. This includes English language and literature; French, German, Spanish, or Latin; history, civics, and economics.

2. The Mathematical Group. This covers advanced arithmetic, plane and solid geometry, algebra, plane trigonometry, elementary surveying, and bookkeeping.

3. The Science Group. This includes physical geography, biology, physics, chemistry, and an introduction to steam and electrical engineering.

4. The Drawing. This is both mechanical and free hand, and includes instruction in clay modeling, in plant analysis for decorative purposes, and somewhat of the history and practice of architecture.

5. The Manual Training. This is the most distinctive part of the curriculum, and includes wood work—joinery, pattern making, turning, and carving; vise work—chipping, filing, and fitting; smithing; sheet-metal work; ornamental iron work, and finally the machine-tool practice in constructive work.

This is a very full curriculum. The studies are all useful, and in the main well selected, but the amount of time that may be given to each is somewhat limited. The principal criticism to which the curriculum is open is indeed right here. It is not possible to offer the full equivalent of the four-year course in three years, and give so much of the time to the manual occupations. Let us look more closely at the disposition of the day. It is commonly divided into six periods of from forty-five to fifty minutes each. As there is no school on Saturday or Sunday, this gives thirty periods a week in which the curriculum must express itself. In the first and second years of the course, half of each day is given to manual work—that is, to tool work and to drawing; and the other half is given to the

academic work, generally one period each to language, science, and mathematics. In the third year, the disposition of the time is somewhat different. About six hours per week, sometimes more, are given to manual training proper, four to drawing, and from four to six to the physical and chemical laboratories. Counting all this work as manual, however, the division of the day practically remains much the same as in the lower classes—that is, half the day to manual and half the day to academic work. Although half the curriculum bears so close a resemblance to customary high-school work, it is hardly practicable to consider the curriculum except as a whole, for in the best schools the course is distinctly a unit course, and the manual training does not form a bit of unrelated work apart from the rest. There is, of course, a tendency in such schools for the faculty to separate into two distinct parties, the academic and the manual, and the more so since the academic men are college-bred, while the manual men are mostly artisans taken directly from their shops, and devoid of even a high-school training. But such a separation is most unfortunate, for it makes the best results impossible. Where there is sufficient perception to see that the one problem is shared by all, and sufficient tact to co-operate in both spirit and letter, it becomes possible to realize the broad purpose of manual training. I confess that the demands made upon human nature by such a scheme are tolerably large, but I think that if you will go among the training schools of the country you will see that these demands are met here and there, and that the schools where they are met are animated by a singularly fine spirit of helpfulness and high purpose. The particular difficulty in the way of manual training just now is in finding men and women wise enough and skillful enough to carry it out. This is especially the case in the manual department. The supply up to this time has been drawn almost exclusively from the artisan class. Some of these men have shown themselves quite equal to the occasion, and have demonstrated anew that teachers are born, not made. But the majority are not satisfactory. The deficiency in general education is a serious drawback to the work of the academic departments, for it inevitably lowers the standard of the school. Particularly is this the case in the matter of language. The English is not the king's. Nor does it seem to me desirable that boys should come under the influence of the artisan view of life. It is bound to be narrow from the very nature of the case, for the artisan life is narrow, and a stream can not rise above its source. A serious objection, too, is that the artisan view of manual training, as I have tried to show, is a relatively poor one. It must suffer a complete change of heart before it can serve the purposes of education, and this is too much to expect from men whose very pro-

ficiency has been gained at the expense of their youth. You remember that when Harvey demonstrated the circulation of the blood, not a single physician in England, older than forty, accepted the new view. Darwin's theory of the origin of species fell for the most part on deaf ears except among the younger naturalists. It is unpsychological to expect men of a certain turn of mind and a certain way of life, and withal no longer young, to suddenly emerge out of their old selves.

The best work of the world is done without pay, the sacred work that asks no pay—the work of the mother, the work of the enlightened ones—but where the work *is* paid for, the rate of pay is a pretty sure gauge of the estimate that is placed upon the work. Now, in some of the manual training schools, the salaries in the manual departments are notably less, I should say about twenty per cent less, than the salaries in the academic departments. This seems to me a grave mistake. If manual training is to be put forward as a serious educational scheme, the teachers of manual training should be men and women quite as carefully educated, quite as acceptable in their language, quite as broad in their sympathies, quite as elevated in their morals—in a word, in every way quite as cultivated as the teachers of language and science and mathematics. And the first practical step in bringing about this equality of requirement would be to inaugurate an equality of pay. The manual teachers should get precisely what the academic teachers get.

In describing the manual training school, I am assuming that it is one in which this unity of purpose prevails, just as, in developing the philosophy of manual training, I assumed the educational view. And if, at times, it should seem that I am describing an ideal rather than an actual school, bear in mind, please, that the picture has at least been suggested by a reality. Let us glance, then, at the several departments in succession.

The humanistic group is weak, especially in English, and this constitutes the gravest weakness of the manual training school as now organized. Adequate results can not be obtained in the time allotted to the studies. In the first year, only five periods a week are commonly given to the entire group, three to English literature and rhetoric, and two to a foreign language, and this, when you consider the importance of the studies, is a mere drop in the bucket. The children are not even well grounded in the bare structure of English. They come up from the so-called grammar schools, where it has seemed to me they learn the rules of grammar all morning, and break them all afternoon. We need really an excess of English, for the poor English heard in the manual departments, and bound, I fear, to be heard for some time to come, ought to be effectively offset, or these

schools will never take their place as true culture schools. There is in Europe, and notably in Germany, a strong nationalistic element in current educational thought. We have a national spirit here in America, but it is apt to take a bad form, a form well expressed in that street cry familiar to you all—"America for Americans"—a cry, by the way, that is commonly uttered with either a brogue or an accent. But the national spirit that we want to cultivate is something quite different. We do not want national pride so much as we want national interest. This can be done by concentrating attention upon the national life, the national problems, the national literature. Furthermore, by this means we could hope to truly nationalize our very heterogeneous population, and weld it into one nation; not one as against the rest of the world, which is the spirit of the cry "America for Americans," but one nation strong enough and alive enough and good enough to work sturdily *with* the rest of the world toward that federation of the nations which is the dream of every lover of humanity.

The three hours a week are given to the study of obvious solecisms and crudities, and to the reading of American authors—Burroughs, Emerson, Thoreau, and others. The instruction fails in not giving the boys a command of the mother tongue, and in not arousing them to a sincere national life. It makes a brave attempt to do this, and it only fails for lack of time.

In the matter of foreign languages, much the same thing must be said. At first only modern languages were taught, and many of the schools adhere to that practice. In Baltimore, only German is offered; in Boston, only French; in Philadelphia, it is German *or* French; in Brooklyn, German *or* Latin, with a chance for some French later; in St. Louis and in Denver, Latin, German, and French are electives; in Chicago, only Latin is offered, with French the third year; in San Francisco, German, French, and Spanish are elective; and so on. I am quoting at such length from these representative schools both to show how variable the practice is, and also to point out that in the more progressive Western schools the studies are largely elective. The customary thirty periods a week are required, for either three or four years, but each student makes out his own roster, subject to the approval of the head master. Here, again, I think they are much ahead of us. In the older Eastern manual training schools the boys take their German or French but twice a week during the first and second years, and three times a week during the third year, and I am afraid that they come out of the school unable to read or write or speak the language with any degree of practical fluency. The time is too short and too scattered.

In the second year history appears in the curriculum—ancient,

mediæval, and modern European history—and with the literature forms a unit course. English as a study does not appear, or else history and English are each given half time, and run through both years.

In the third year three periods are given to United States history, civics, and economics, and two to literature and theme writing. The nationalistic work here is commonly of high grade, but the English is weak, and the whole structure rests upon insufficient foundations.

It remains for me to suggest how the manual training idea, that of learning by doing, is applied to studies apparently so abstract, for undoubtedly the idea does permeate the entire English work. The one effort is to give reality to the instruction and to make it arouse the self-activity of the boys, to have it creative rather than merely assimilative. To carry out this idea, the composition work of the first year is limited to subjects in which the material can not be had from books, but must result from direct personal observation and experience. In the second year the history and the literature are closely correlated, and each lends an interest and reality to the other. For example, when ancient history is being studied, the literature will belong to that period—Plutarch's Lives, or portions of the Iliad, or some of the excellent translations of Greek plays, the Alcestis of Euripides, or the Antigone of Sophocles. Boys are thought not to care for literature, but really they take a keen delight in the more full-blooded sort. They may not care for subtleties of thought, but they do care for action, and they sympathize with the strong primitive passions of the Greek heroes. And it seems to me very wholesome in these cold northern winters of ours to have the boys plunge into the open sunshine, the pure animality, the sincere passion of the Greek world, and return warm and invigorated. Ivanhoe, or Men of Iron, is good collateral reading for mediæval history. I have known a non-book-loving boy to read Men of Iron three times in less than a fortnight. Kingsley's Water Babies is a good breath of the modern spirit. The American work, if I may so call the history, civics, and economics of the third year, is made strong and real by the use of original documents, by local illustrations, and by the study of current social problems. Here, again, it all depends on the man. In the hands of the unimaginative, economics is apt to become a mere effort to formulate social abuses with the idea of justifying them, and the boys get little inspiration out of such dreary work. The English work is still formal. The boys read Shakespeare and other middle English authors, works that I have come to believe had much better be left until the boys come to them privately and of their own accord.

Let us look now for a moment at the work in mathematics. In

the main, it is quite satisfactory, though the bookkeeping seems to me to have little educational value. In the first year, five periods a week, and in the second and third, an average of four, allow a reasonable though not a generous amount of time for what is attempted. The mathematical sequence is not the same in all the schools. The most typical is probably still the older scheme—advanced arithmetic, algebra to quadratics, geometry, advanced algebra, trigonometry, surveying, and bookkeeping. A partial inversion of this scheme would seem to me a better sequence, and I have carried it out in part, with results that confirm this opinion. There are three terms a year, so that we have in all nine terms of thirteen weeks each. I would suggest, then, plane geometry, two terms; elementary algebra, one term; solid geometry, two terms; elementary algebra and advanced arithmetic, one term; algebra, one term; plane trigonometry, one term; and surveying, one term. I would omit the bookkeeping. This sequence is, I think, logically defensible. The main idea in having geometry precede algebra is that the geometry is much more graphic and makes a far more direct appeal to the senses. The geometry may be made the means of the most excellent mental gymnastics if the chalk diagrams are for a time dispensed with and mental diagrams made to take their place. This was suggested, you know, by Herbert Spencer's father. We made the experiment at the Northeast School, and again at Chestnut Hill, and the results were very gratifying. While the putting of arithmetic after geometry and algebra may excite the greater surprise, it is practically the most defensible part of the whole inversion. The most important processes of advanced arithmetic are only explainable on algebraic or geometric grounds. Take, for example, the process of extracting the square or cube root of a number. I do not know of any simple arithmetical explanation of the process. There is only an empirical rule, and this has no educational value. It is a very simple matter, however, when the binomial theorem has been mastered, or it is a very simple problem in solid geometry. The surveying is practical, and is of course limited to the most elementary problems. There are few boys who do not enjoy it, however, and who do not get something of real educational value out of it.

The science work is good, and the sequence has been pretty carefully worked out. It is all laboratory and lecture work, and is made just as practical as possible. Indeed, it might almost be called a department of manual training, so strong is the desire to have the boys learn by doing, and through their own self-activity. During the first year, five periods a week are given to science, the work being in biology and physiography. This part of the work is, however, open to improvement. The present course is logical, and appeals to older

minds as an admirable scheme. But boys of fourteen are not logical, and in science they are in too new and untried a field to appreciate the fact that the simple organisms and tissues they study under the microscope are the basis of a more interesting life. A philosophy with coherent, dependent, and interrelated parts, which you remember Mr. Frederic Harrison charged Arnold with lacking, does not make a very far-reaching impression on boys of this age. I believe the important thing is not to attempt to give the children a systematic knowledge of any part of natural history, but rather to arouse in them a keen and affectionate interest in the study of Nature. First impressions count for so much. The boys are just beginning the serious study of science, and it is so important that they should be fired by it, and not for a moment repelled. The cut-and-dried and systematic have their place, but not, I think, in secondary science work. And so I am advocating the seemingly illogical process of beginning at the end instead of at the beginning—of making, in truth, a very open bid for the boyish interest, and starting out with dogs and cats and horses and chickens and pigeons; with trees and flowers and vegetables, in place of lower and, from the childish point of view, less interesting organisms. In the same way, rocks and minerals and ores have more to teach than the more abstract chemical elements. Later, it may be, the work can lead back to the simple forms, and build up a world logical enough to suit Mill. But at present the boy is interested in the big things that he finds in his world, and would much prefer to investigate them. I believe that he is right, and that our elementary science work wants to be more thoroughly superficial, and less superficially thorough. I am not ashamed to recommend a return to the surface of things.

The second year's work in science is devoted to physics—to mechanics, heat, light, and sound. The work here is rich in possibilities, and is limited only by the ingenuity and skill of the teacher. It is work, too, that can be brought into the closest relation with the manual departments. Any number of projects in the way of physical apparatus can be made in wood and metal. The more of the apparatus is home-made and home-devised, the more truly practical and educational is the work. There is also a danger here that the instruction will run too much to measurement, and not enough to the experimental and phenomenal. I put in this word of caution because the teachers are mostly college men, as we want them to be, but men who have been so deeply drilled in laboratory methods of work and thought that they may have come to look upon the entire phenomenal world as somewhat of a divine concession to the vulgar mind. This attitude, I think, is unfortunate educationally.

The third year's work in science is particularly strong. From

three to six periods a week in the older schools are given to chemistry, a practical laboratory course in inorganic; and three periods to physics, to the special study of steam and electricity. The tendency at one time was to make the electrical work almost too practical. It grew to be weak from a lack of fundamental instruction. But this tendency is now being corrected, and the work put on a much sounder basis. There are, however, plenty of chances for practical work. The schools all have their own steam engines and dynamos, switchboards and installations of electric lights and bells. There is plenty to be done in running the engine and dynamo, and in repairing and renewing the several installations, as well as in the more strictly quantitative work of the laboratory proper. To an active boy the attractions of electricity are simply irresistible, and this department, which in the early days was known by the too ambitious name of the electrical engineering department, has not only been a source of lively interest, but in no small measure a determining factor in the future career of many of the manual training graduates.

The work in drawing in nearly all the manual training schools is admirable. It continues throughout the three years; five periods a week during the first and second years, and four periods during the third. A little more than half the time is given to mechanical drawing, or, as we prefer to call it, constructive drawing, and the work is in the closest possible relation with the manual departments. The practice is not uniform. In some schools the boys make the drawings for all the articles that they afterward construct in the workshops. This has the manifest advantage of giving reality to the work, and making it continuous and practical. On the other hand, one can draw much faster than one can construct in wood and metal, and many of the projects, being somewhat similar from the draughtsman point of view, do not offer sufficient range of experience to form an ideal course. In many of the schools, therefore, it is growing to be the custom to modify the drawing, giving only a few selected exercises of the manual departments and the special projects, and adding an independent course of drawings chosen because they involve useful problems in draughting, and require the original working out of details. The steam engine is naturally a prolific source of such problems. By giving an outline dimensioned drawing, and then assigning to different boys a specific position of the piston, it is possible to teach not a little mechanics along with the drawing. In the same way the development of curved surfaces in the drawings for the tinsmithing work involves a helpful amount of applied geometry. As a rule, the manual training schools turn out very good draughtsmen. I think this is because the work is so real. Few of the

later drawings are mere copies. They have enough in them that is original to require that they shall be understood before they can be made. The free-hand work is no less important. From an evolutionary point of view it is even more important, for it requires greater power and greater concentration, and in developing the æsthetic faculty it makes an even more substantial contribution to life as a fine art. The work is similar to the elementary work of the art schools. It is in touch with the shops in supplying all the designs for the ornamental iron work and for the wood carving, and it includes, on the constructive side, an important part of manual training, and one that I hope to see still more developed in the future, the work in clay modeling.

I have purposely left the consideration of the strictly manual training part of the curriculum—that is, the tool work—to the last, and I have done this that I might make it very clear that the humanistic studies, and the mathematics, and the science, and the drawing are quite as essential a part of the school as the tool work; and also that I might make it very clear, beyond all peradventure and even perhaps at the expense of repetition, that manual training is a scheme of education, a deliberate attempt to shape evolution toward definite social and moral and æsthetic ends, and is very far from being a mere system of hand training. At its best, the school is a practical as well as a philosophic unit. It has one purpose and one method.

The instruction in tool work occupies about one third of the entire time—that is, ten periods a week. In the first year, at the older schools, this is equally divided between wood and metal. In the disposition of the time, the different schools are pretty much agreed. In the details of the work no two schools are alike. All the manual training work is still fluid and experimental; but, to hear some of us talk, you might think that there was something quite fixed and sacred about it all. You have perhaps remarked the very solemn and knowing air that the tailor takes on when he assures you that a certain coat or gown is or is not in style. I never quite believe him; but, nevertheless, I am always impressed that any one should even pretend to have such inscrutable knowledge. It is a little bit the same here.

The wood work during the first year may consist of two terms of joinery and one of turning. It is very attractive work. There is something fresh and sweet about the smell of the wood. It conjures up all sorts of pleasant pictures of sawmills and logging camps, and, though it is a passing pain to remember that the tree has been cut down, if you happen to be a lover of trees, still the wood never seems quite a dead thing. The feeling grows very strong, as you stand in the wood shop, that you would like to stop there and go to work

yourself. You remember, perhaps, that Jesus was a carpenter. You recall good Adam Bede and Dinah Morris. You see again the touching little wooden saints and angels on the stalls of the Antwerp Cathedral, and quite before you know it the occupations of the woodworker have become idealized and have passed from labor into joy. It is pleasant, too, to go again from day to day, and, as one term melts into another, to note the growing skill, the quickened intelligence, the greater aliveness on the part of the little workers. At first they are so awkward and helpless; they seem to have so small control over their organisms, and they are half ashamed of their pitiful little efforts. But all this changes. There comes not only skill, but a sense of skill, and a sturdy self-reliance that amuses while it pleases you. They seem to be passing into control of themselves and to know it. They are delightfully unconscious of you, and quite regardless, too, of your criticism, unless indeed it coincide with their own. They soon come to know whether a piece of work is good or not, and are as generous in praising the skill of a neighboring worker as they are frank in ridiculing his failures. I should like to give you an instance of this sturdiness: I had once a very solemn little boy in my science classes, whose delight it was to read Forney's Catechism of the Locomotive. He kept a little notebook in which he entered his difficulties in the form of questions. When he had a sufficient cargo of these, perhaps ten or a dozen, he would come sailing into the lecture room after school and present them one by one. I had answered seven or eight of such questions one afternoon, when we came to some detail of the steam cut-off. I could only answer on general principles, and told him that the answer was a partial one. He looked at me very solemnly and said: "I will take this question to Mr. Whitaker. I think he can answer it better than you can." I was immensely pleased.

But, as I say, the first impression on going into these workshops is not with the work, but with the workers, and I think it is high commendation when in any school you are more taken up with the children than with the process.

The work in joinery mainly involves the use of the saw, plane, chisel, and rule. Hammer and nails, sandpaper, glue, and shellac are taken for granted. The sandpaper and shellac are secondary, and are quite discountenanced if used to cover up defects. The term joinery is well chosen. The work covers all sorts of joints and frames, and joinable and fittable things. The wood turning, I think, is less valuable than the stricter hand work, though it does undoubtedly cultivate an accuracy and delicacy of touch, combined with quickness that might not result from slower operations. It is also possible that the inartistic forms produced by our turning mills and

displayed with such prodigality in the construction of cheaper houses does something to prejudice one against the lathe. The forms turned out in the schools are not all beautiful, but they might be. They consist of rings, balls, vases, tumblers, balustrades, dumb-bells, Indian clubs, and the like, and are very sound and true in the matter of workmanship.

The manual work for girls during the first year usually includes joinery and sewing. The homely arts of mending and darning are taught, and also the more scientific processes of draughting patterns and cutting out garments.

The second year's work in wood may cover two terms in pattern making and one in carving. The main tools are the saw, plane, chisel, gouge, lathe, sandpaper, and gluepot. The work in pattern making is wonderfully nice and exact, and makes other wood work seem rough by contrast. Pattern makers as a class know this, and show a becoming appreciation of their own work. They quite look down on less exact workers. I have often wondered that, with their immense skill in wood and varnish, they do not turn to some more profitable and artistic work—such, perhaps, as violin making. The art of Stradivarius and Guarneri and Amati might prove recoverable. The present work in pattern making is very technical, and can not be other than an industrial abstraction, since the patterns are only used for forming the molds into which the molten lead and iron are afterward to be cast.

The wood carving is more human and more artistic. It used to be very elaborate and in very high relief; but this meant that the teacher had to do too much of it. It is now less ambitious and truer. The articles are smaller, and the carving is in lower relief. The so-called chip carving, borrowed from sloyd, has been introduced with advantage. It is effective artistically and is well within the boys' capacity. The regular wood work ends with the second year. In sloyd schools, wood is the material most used, and I think that it will occupy a larger place in the manual training school proper as the educational idea prevails.

The girls, meanwhile, during this second year, have also been taking wood carving, and have been extending their knowledge of sewing by fitting garments as well as cutting them out, by using the machine, and by instruction in the selection of materials.

The work in metal is limited, of course, to the boys. It is more varied and elaborate, and from an indusrtial point of view also more important. It is not, however, so attractive as the wood work. The noises are more trying—the anvil chorus is only one out of many possible sounds. Nor are the odors of the metals agreeable. The pictures of mine and furnace that they bring up are not pleasant.

Back of them stand the begrimed and impoverished workmen. Tubal-Cain was doubtless a strong man, but he does not greatly touch the imagination. You may think it a fancy, but I can not help believing that the hard and glittering surfaces of the metal exercises have a less humanizing effect than the other manual work. These influences of sound, color, texture, odor, and touch are very subtle, but they are not to be neglected, and particularly in the case of young children. I should therefore like to see the metal work somewhat reduced in amount, and thrown toward the end of the course. Its place could well be taken by work in wood and clay. I am glad to see that this is now being done in the majority of manual training schools, and that no metal work is introduced in the first year. In the early days, the poor little first-year boys used to have three solid terms of vise work, and it was somewhat dreary. Where the elementary metal work is still distributed over the first and second years, care is now taken to make it less monotonous. There may be one or two terms of vise work, one of sheet-metal work, one of molding and casting, one or two of smithing, and one of ornamental iron work. This is still the sequence in Philadelphia, but elsewhere the tendency is to throw the joinery and carving and part of the turning in the first year; the pattern making, molding, and smithing in the second; and to leave the vise work until the last year.

The most interesting and important of the metal work is undoubtedly that of the third year, the machine-tool practice and the construction of finished articles in the way of apparatus and machines. In the hands of a scientific man this department can be made to yield very rich results. The instruction may include so much to arouse and awaken a boy and bring reality into life and thought. Here he can learn to interpret mechanical drawings—a large training for the imagination; he can learn the niceties of mechanical construction, and by means of vise work, lathe, drill, planer, and shaper can turn his designs into solid facts in three dimensions; here he can embody scientific principles in suitable forms; can test new plans by carefully constructed models; he can do a hundred things that are useful and helpful, and will bring him into possession of himself. The work does not always take this broad turn, for it requires a very broad man to give it such a turn, but in estimating it, it is proper, I think, to value it for what it may become as well as for what it is.

Meanwhile, the girls have not been idle. They have been deep in the mysteries of cookery and domestic economy—mysteries so deep that I had better leave them to your imagination, for they would require of themselves a long chapter. But it is to be remarked that the occupations of the girls have nearly all of them a distinct prac-

tical end rather than a direct educational purpose. But they are defensible, I think, on the same broad grounds that the occupations of the farmer are defensible, that they contribute directly and essentially to the maintenance of life, and, like his, they may be made artistically excellent. Well-dressed men, women, and children, well-fed men, women, and children are ethical realities still far in the future. When you remember that we are dressed during the whole period of our social life and that we eat three times every day, eleven hundred times a year (allowing an occasional late supper), it is astonishing that these very human arts have not been brought to greater perfection. So I would not disparage the practical turn that is being given to the girls' education any more than I would disparage the practical arts which minister to distinctly human ends in the culture of the boys. But I do insist, quite as uncompromisingly for the girls as for the boys, that the arts of life are secondary, that the major end is life itself. And I hope to see manual training for girls given such a human and æsthetic turn that it will mean not only more accomplished home makers, but in even a deeper sense more perfect and more charming women.

I have tried to present an adequate picture of the manual training school. One will get a better picture if one will supplement this criticism by a day spent in the school itself.

WOMEN IN SCIENCE.

By HENRIETTA IRVING BOLTON.

A GREAT deal has been written of late years in regard to the "new woman"; a somewhat vague term expressing the contrast between the clinging, fainting, willowy heroine, dear to the hearts of our grandmothers, and the alert, athletic, breezy woman who rules the world to-day. According as the phrase is used, it becomes a title of honor, or a term of reproach; but in either case we are apt to look upon the "new woman" as a *fin-de-siècle* production. The "sweet girl graduate with her golden hair," who

> "Knows the great-uncle of Moses
> And the dates of the war of the roses,
> And the reasons for things—
> Why the Indians wore rings
> In their red aboriginal noses,"

we regard as an outcome of this century, and we have only just become accustomed to the idea of women physicians.

That women should hold professors' chairs in the great female

colleges seems quite right and proper; but think of the thrill of surprise and dismay which would fill the breasts of the mothers of this land should a lady, young and attractive, be appointed to train the masculine mind at Yale or Harvard!

On women lawyers we still look askance, at least in the Eastern States, and despite the attractions of some of the female divines, it will be "long after to-day" before women clergymen, a strangely contradictory term, win any large or enthusiastic following.

The fact remains that, with all our boasted progress and enlightenment, our age is much behind the past, and for a perfect type of the "new woman" we must go back to Miriam, the sister of Moses. She was no shrinking creature, hiding her light under a bushel; an accomplished musician and a poetess, she dared to assert herself, and to lead the Israelites with timbrels and with dances in their song of triumph upon the overthrow of Pharaoh and his horsemen in the Red Sea. She was also, so says tradition, learned in the sciences, and invented the *bain-Marie*, the double boiler of our kitchens, which still bears her name. She was an authoress as well, and wrote a practical treatise on alchemy which is still extant. She was a true woman in her love of gossip, and was most severely punished for "evil speaking, lying, and slandering," when she and Aaron expressed their opinion of their sister-in-law, the Ethiopian wife of Moses.

In 1894, Monsieur Rebière, a French mathematician, delivered a lecture entitled *Les Femmes dans la Science*, which was published in a small pamphlet of eighty-seven pages; this *brochure* he recently enlarged into a work of three hundred and fifty-nine pages, including more than six hundred names of women more or less distinguished in scientific pursuits. It is true that in order to swell the number the writer has included some names on insufficient grounds, and others about which he has no definite information; but the greater part of the book consists of short, well-written biographies, giving interesting and valuable insight into the lives of the women of all ages and countries who have made useful discoveries or profound studies in the various branches of science.

Although M. Rebière has omitted Miriam from his long list, we find sufficient details concerning women of ancient and mediæval times to convince us that the wearing of blue stockings is by no means a modern fashion. Nor are those who adopt the azure hose always the unattractive and elderly; on the contrary, their portraits show them to have been very fair to look upon. Indeed, so lovely was the beautiful Novella d'Andrea, the daughter of a professor of law at the University of Bologna in the fourteenth century, that when she took her father's classes she was obliged to lecture behind

a curtain, in order to prevent the students, one and all, falling victims to her charms.

Among the ancients, mention is made of Athyrta, sister of Sesostris, who is said to have been an astronomer; Berenice, wife of Ptolemy III, King of Egypt, whose hair has given name to one of the constellations; Agnodice, the first female medical practitioner, who lived three hundred years before Christ; and the great Cleopatra, who is credited with possessing medical and chemical knowledge, besides occult powers.

At a later period we read of Hypatia, the romance of whose short and brilliant life is well known through the pen of one of England's most popular writers. She has obtained a place in the history of science by her extraordinary knowledge of mathematics; she taught geometry, algebra, and astronomy, and is said to have invented astronomical and chemical instruments. It is a remarkable fact that the story of the pagan maiden, murdered by Christian hatred, should have become transposed into the world-wide legend of St. Katherine of Alexandria, the beautiful, young, and learned martyr-queen.

Among the learned women we find St. Hildegarde, foundress of the Monastery of St. Ruppert on the banks of the Rhine, whose great work *De Physica* contains many personal observations of Nature. It treats of the rivers of Germany, of the nature and properties of metals, of vegetables, fruit and flowers, fish, birds, and quadrupeds. She seems to have been acquainted with the circulation of the blood, the physical phenomena of the tides, and with many other wonders of Nature. "The naturalist," says a recent writer, "finds in Hildegarde the germs of many modern discoveries." St. Hildegarde, who died at a great age in 1180, is a patron saint of physicians, and is often represented in art with a book or a pen in her hand.

The ancient universities of Italy early recognized the intellectual abilities of women, giving them every opportunity of gaining and imparting knowledge, and for several successive centuries numbered women among their most honored professors.

During the eighteenth century, three distinguished women were at one time occupants of chairs in the University of Bologna, one of the oldest and most important seats of learning in Italy: Maria Agnesi, Laura Bassi, and Anna Manzolini. Of the three, Laura Bassi was a few years the senior, having been born in 1711; she was a precocious child, and was early considered a prodigy of learning, being proficient in mathematics, Greek, and philosophy. While still quite young, she attracted the notice of Cardinal Lambertini, afterward Pope Benedict IV, and when only twenty-one was given the chair of philosophy in the university, a position which she held for twenty-eight years. In 1738 she married a physician,

J. J. Veratti, and became the mother of twelve children. She is spoken of as an excellent housekeeper, a judicious mother, charitable and most earnest in good works. Two years before her death she was appointed professor of physics at the university. Her personal appearance is thus described by a contemporary writer: "Laura Bassi has a countenance slightly marked by smallpox, but of a sweet and tranquil expression; her black eyes are sparkling, and she is serious and composed in manner without affectation or vanity."

Even more remarkable seem to have been the attainments of Maria Agnesi, born in 1718. She was one of the twenty-three children of a rich citizen, who must have needed all his wealth to bring up such a family. One of her sisters was noted as a musician, and was the author of three operas. Maria has been called the oracle of seven languages, speaking French fluently at the age of four, and early becoming proficient in Hebrew, Greek, and Latin, as well as German and Spanish. After spending her youth in the study of philosophy and philology, at the desire of her father, she devoted herself to mathematics, in which she attained such celebrity that she was complimented by Pope Benedict IV, who nominated her as professor of mathematics in the University of Bologna, a position she held for several years. At the death of her father she abandoned her chair and her studies to fulfill a long-felt desire for a religious life. She entered the Blue Sisterhood of Bologna, and spent the remainder of her long life in works of mercy and charity, gaining the name of the "servant of the poor." Her portrait and the contemporary accounts of her appearance show her to have possessed much beauty; in character she is said to have been modest, gentle, and almost timid.

Less gifted than these two women, but equally renowned, and whose knowledge has been of far greater practical value, was Anna Moranda Manzolini, a woman of humble origin, and the wife of a poor maker of anatomical models. Beginning as an assistant to her husband, she soon surpassed him in knowledge of his profession, and being encouraged by a friendly physician, she began to give lectures on anatomy. So great was her skill in dissection, and so clear were her demonstrations, that she soon acquired a European reputation, and her lecture room was thronged with students of all nationalities. After the death of her husband she accepted the professorship of anatomy at the University of Bologna, where her collection of anatomical models still bears silent testimony to her remarkable skill and accurate knowledge of the human frame.

Turning to France, we find at this period the Marquise de Châtelet, the friend of Voltaire, a woman "without faith, without manners, and without modesty," but deservedly famous as a mathe-

matician, the author of many books, and the translator into French of the works of Newton; the beautiful Mademoiselle Delaunay, student of astronomy, geometry, physics, and anatomy; and others less distinguished.

A little later we read of Madame Lavoisier, who assisted her husband in his chemical experiments, learning English and German in order to translate for him the scientific works written in those languages, as well as engraving, in order to be able to illustrate his writings; the plates in his treatise of Elementary Chemistry all bear her signature. Madame Lavoisier was very beautiful, and her face is familiar to all through the celebrated portrait by David, which represents her standing behind her husband as he sits at his worktable. After the death of Lavoisier, who perished on the guillotine, his widow married Count Rumford, and lived to a great age.

Sophie Germain, born in 1776, is another French woman noted as a mathematician; she has been called one of the creators of mathematical physics. Her tomb at Père-la-Chaise is still often decked with fresh flowers. A high school for girls and a street in Paris have been named in her honor.

The recently published memoirs of Sophie Kowalevski have shown the difficulties which a Russian woman has to overcome in order to obtain the higher education, and they are also most pathetic, showing that neither science and learning nor the honors they bring can satisfy the deepest longing of a woman's heart. Full as are the pages of the record of her intellectual achievements, and the brilliant success of her genius, they are none the less the record of an unsatisfied and empty life.

Monsieur Rebière does full justice to the fame of Caroline Herschel, Mary Somerville, and our own Maria Mitchell, whose names and achievements are too well known to need mention here, and he also gives short biographies of many women now engaged in scientific pursuits in England and America: among them Miss Agnes Mary Clerke, author of many important works on astronomy; Miss Charlotte Angas Scot, one of the great living mathematicians, born in England, and now professor of mathematics at Bryn Mawr; Mrs. Ladd-Franklin, a graduate of Johns Hopkins University, not only noted as a mathematician, but as a student of logic and physiology; and others. An interesting account is given of Miss Dorothea Klumpke, born in San Francisco, and to-day "one of the foremost astronomers of France," where she is on the staff of the Observatory of Paris.

In studying the lives of those women who have been distinguished in science we are forced to the conclusion that their genius has but a limited field; while many have obtained fame through

their knowledge of mathematics and its application to astronomy, they show but little aptitude for the natural sciences, and rarely exhibit any inventive faculty.

That a learned woman *can* be a happy wife and good mother such lives as Mary Somerville's and Laura Bassi's show us; that learning alone does not satisfy we learn from Sophie Kowalevsky.

Perhaps those women who have found the greatest happiness in their studies are those who, like Madame Lavoisier and Caroline Herschel, have been able to assist some loved one to perfect his researches. As a general rule the scientific woman must be strong enough to stand alone, able to bear the often unjust sarcasm and dislike of men who are jealous of seeing what they consider their own field invaded. This masculine attitude has been summarized by De Goncourt, who writes: "There are no women of genius; when they become geniuses they are men."

THE ROMANCE OF RACE.

By GRANT ALLEN.

LET us begin, like a wise preacher, with a personal anecdote. It happened to me once, many years since, to be taking a class in logic in a West Indian college. The author of our text-book had just learnedly explained to us that personal proper names had no real connotation. "Nevertheless," he went on, "they may sometimes enable us to draw certain true inferences. For example, if we meet a man of the name of John Smith, we shall at least be justified in concluding that he is a Teuton." Now, as it happened, that class contained a John Smith; and as I read those words aloud, he looked up in my face with the expansive smile of no Teutonic forefathers: for *this* John Smith was a pure-blooded negro. So much for the pitfalls of ethnological generalization!

Nevertheless, similar conclusions on a very large scale are often drawn on grounds as palpably insufficient as those of my logician. Facts of language and facts of race are mixed up with one another in most admired disorder. If people happen to speak an "Aryan" tongue, we dub them Aryans. We take it for granted one man is a Scot merely because he is called Macpherson or Gillespie; we take it for granted another is an Irishman on no better evidence than because his name is Paddy O'Sulivan. Yet a survey of some such delusive examples will suffice to show that all is not Celtic that speaks with a brogue, nor all Chinese that wears a pigtail.

Some familiar instances of outlying linguistic or ethnical islands,

so to speak—little oases of one speech or blood or religion in the desert of another—will serve to lead up to the curious romances of ethnology and philology which I mean to huddle loosely together in this article. Everybody is familiar, of course, with such stories as that of the mutineers of the Bounty, who founded the colony on Pitcairn's Island, where a little community, about one quarter British and three quarters Polynesian, preserved the English language and the Christian religion for many years, without the slightest intercourse with the outer world. Equally significant in their way are the belated islands of Celticism in America, such as the Highlanders of Glengarry, in Canada, who migrated in a mass, and who still speak no tongue but Gaelic; or the Glamorganshire Welsh of the Pennsylvanian mining districts, who inhabit whole villages where Cymric is now the universal language. Again, we may take as typical examples of such insulation in the matter of religion the Abyssinian Christians, almost entirely cut off for centuries from the rest of Christendom by the intrusive belt of Nubian and Egyptian Islam. Who does not know, once more, that strange outlying church, the Christians of St. Thomas, whom the early Portuguese navigators found still surviving on the Malabar coast in India? Though believing themselves to derive their Christianity from the preaching of St. Thomas, these native sectaries are really a branch of the Nestorian Church of Persia—a distant scion of the Patriarchate of Babylon. Founded in the sixth century, their sect was recruited by successive flights of refugees from the revived Zoroastrianism of that date, and the triumphant Mohammedanism of succeeding generations. Their sacred language is even now Syriac. Or, finally, may we not take the racial islands, like the ancient Basque nationality in France and Spain, the Black Celts of Ireland and Scotland, and the Germans of Transylvania? side by side with whom we may place the scattered and intermixed races, like the Jews and the Gypsies, who still preserve some relics of their ancient tongues, while speaking in each country the language of the inhabitants. It will be clear at once from so rapid a survey of these few familiar instances that a map of the world, colored by race, by speech, or by religion, would be dotted all over with insulated colonies, as quaint and suggestive in their way as that of the mutineers of the Bounty.

Consider, as one striking and well-known example, the curious history of the Parsees, earlier pilgrim fathers of an Oriental Mayflower, who fled eastward and southward before the face of Islam in Persia to the west coast of India. Their very name means Persians; they are the remnant of the ancient Zoroastrian religion, followers of that shadowy and doubtful prophet, whose very exist-

ence has been called in question by the skepticism of our century. But whether or not there was ever a Zoroaster, it is certain, at least, that Zoroastrianism flourished in Irania, from Tibet to the Tigris, at the time of Alexander; and that it declined before the fashionable Hellenism of the Seleucidæ, or, later, of the Parthian and Græco-Bactrian kings. Gradually, however, the Hellenic influence in inner Asia "petered out," as an American miner would say, for lack of fresh Greek blood, till at last hardly anything tangible was left of it save Greek names in Greek letters on coins of barbaric kings. Then a native dynasty, that of the Sassanians, upset the last of the half-Hellenized Arsacidæ, and the Zoroastrian faith, which had lingered on among the people, became, at the beginning of the third century after Christ, the established religion. The Magi had things all their own way, and persecuted Greek thought with the zeal of inquisitors. For four hundred years the creed of the Zend-Avesta held sway in Iran, till the Caliph Omar bore down upon the land with his victorious Mohammedans. The mass of the population were "converted" *en bloc* by the usual argument of Islam, at the battle of Nahavand; and the faithful remnant, who declined to accept the creed of the Prophet at the point of the sword, fled as best they might to the desert of Khorassan. A few thousand persecuted and despised Zoroastrians, known as Guebres, still linger on in the dominions of the Shah; but the greater part of the incorruptible took ship to India, where they settled for the most part in the neighborhood of Bombay and the other trading towns of the western coast. As they never intermarry with Hindus or Mohammedans, they still remain pure, both in race and religion, and can not be regarded as in any sense representative of the people of India. Their sacred language is still the Zend of the Avesta, and their fire worship is as pronounced as when they fled from Persia.

These historic examples are familiar to most of us. Far more interesting, however, are the prehistoric facts of similar implication, which are known to few save the students of ethnology. It is not everybody, for instance, who is aware that the language of Madagascar is not African at all, but a pure Malayan dialect. The ruling race of the island (till France displaced them) were the very unnegrolike Malayan Hovas. Now, the Malays in their day were the Greeks or the English of the Indian Ocean. Just as the Hellenic race annexed the Mediterranean, turning the inland sea with their colonies into a "Greek lake" (as Curtius calls it), and just as the "Anglo-Saxon" race annexed the Atlantic and the Pacific, colonizing the United States, Canada, South Africa, and Australasia, so did the Malays annex the Indian Ocean, penetrating

every part of it in their light pirate craft, and settling where they would among subject populations. They may be compared with the Phœnicians in the earlier world as pioneers of navigation among the far-eastern islands.

The aboriginal people of Madagascar, again, were apparently not African at all, but members of the still more ancient Melanesian race, which is scattered in little groups over so many parts of the Pacific and the Malay Archipelago. This race apparently spoke already, at an early date, the common Malayo-Polynesian tongue—that widespread speech which, as we now know, forms the basis of all the dialects in use from Madagascar itself, right across Java, New Zealand, and Melanesia, to the Sandwich Islands and the very shores of America. And, what is odder still, the Malagasy dialect of the present day approaches nearest to that of the Philippines and of Easter Island. In other words, at these immense distances relics of an ancient common language survive, which elsewhere has undergone specialization and simplification into the modern Malay of Java and its neighborhood. It is almost as though somewhere, among scattered villages in Portugal and in Roumania, people were still speaking tolerably pure Ciceronian Latin, which elsewhere had glided by imperceptible degrees into French and Spanish, Italian and Provençal.

The lowest and oldest layer of the Malagasy population thus probably consists of black, woolly-haired Melanesians; above it come true yellow-brown Malayan immigrations, the last of which is apparently that of the dominant Hovas. These two have intermarried more or less with one another. But there is also a true negro admixture on the side nearest Africa; while the intrusive Arab has, of course, established himself along the coast line wherever he found an opening for his peculiar genius. Thus, even before Christianity and the European element came in to disturb our view, the ethnical facts of the island were tolerably mixed, and presented several problems on which I have not space to touch. But if this seems a good deal of ethnology for a single land, we must remember that Madagascar would cut up into four of England; and even in our own country the known elements of the population, Silurian, Cymric, Brigantian, Cornish, Anglian, Saxon, Norwegian, Danish, Norman, and so forth, are sufficiently numerous; while modern anthropologists would probably fight hard for an admixture of Palæolithic, Neolithic, Roman, Dacian, and Spanish elements, as well as for a trifling fraction of Jewish, Gypsy, Huguenot, and negro blood. It is a truism now to say that "there is no such thing as a pure race"; every individual, especially in civilized countries, is a meeting place and battlefield for endless hostile and conflicting ancestors. Our idiosyn-

crasy depends in the end upon the proportion of each which comes out victor in the formation of our character.

Take the single kingdom of Scotland alone. Englishmen are carelessly wont to suppose there is such a thing as a Scotch temperament. Scotchmen know better. Even if we omit from the reckoning such remoter and more doubtful elements as Black Celts, and so forth, we may say, roughly speaking, that Scotland consists of six distinct nationalities—the English of the Lothians, the Welsh of Strathclyde, the Irish Scots of Argyllshire, the true Gaels of the Highlands, the Picts of the east coast, and the Scandinavians of Orkney, Caithness, and Sutherland. All these, of course, though in some places tolerably pure, are in others inextricably intermingled; while outlying islands of each, such as the Picts of Galloway, are universally recognized. The "Little England beyond Wales" in Pembrokeshire, mainly peopled by Flemings, who are English in speech among a Welsh-speaking population, forms a similar example in the southern half of our island; while, conversely, little outlaw communities of Welsh-speaking Britons are known to have held out in the eyots of the Fens for many generations against the conquering English of East Anglia and Mercia.

Take a linguistic case again. How strange it would seem to us to-day if there existed, say in Newfoundland, a colony of Anglo-Saxons, sent there by King Alfred, and speaking still the pure old Saxon tongue of King Alfred's Wessex! Yet this would exactly parallel the case of Iceland. While Danes and Swedes have modernized the ancient Scandinavian of the Sagas into the Danish and Swedish of the present day, the Icelanders still go on speaking the tongue of their forefathers pretty much as it was spoken by Rolf the Ganger and Harold Hardrada; they read the Sagas in the tongue of the old singers as easily as our children can read Shakespeare and the English Bible. Mr. Steffanson, the learned Icelander, tells me another interesting fact of the same sort. It seems the women in certain parts of Normandy still wear a peasant cap with silver ornaments identical to this day with the cap commonly worn by Icelandic women. I need hardly add that the names of Norman villages are but Frenchified corruptions of the old pirate nomenclature—Ivo's toft has been shortened to Ivetôt, while Hacon's home has declined into Haconville.

On the other hand, nothing is more fallacious than the old-fashioned argument from language to kinship. It used once to be thought there was a "great Aryan race" because there were many peoples who spoke the Aryan languages. I doubt whether even Professor Max Müller himself really believes nowadays in Our Aryan Ancestor; certainly, for the rest of the world, that exploded old

humbug has vanished into the limbo of central Asia, whence he never came, according to our latest authorities. (If he existed at all, it was probably in Scandinavia.)

A race, indeed, may speak the language of another without having received any appreciable admixture of its blood; just as, for example, the pure-blooded negroes of the West Indies and the Southern States speak no tongue but English, Creole French, or Spanish. So, again, English has become the language of Ireland, without interfering to any large degree with the Celtic nationality of the people; indeed, writers who talk about the "Anglo-Saxon race" in America and the colonies forget that the Anglo-Saxon who emigrates is generally either an Irishman, a Welshman, or a Highland Scot, without prejudice to the chance of his being a Cornish miner or a Celtic Yorkshireman. Through these Anglicized Celts, the English language has taken possession of North America, South Africa, and Australasia; not only is it swallowing up the French of Canada or Louisiana, the Spanish of California or New Mexico, and the Dutch of the Cape, but in the New World it has blotted out the African and Indian tongues, and is assimilating in the second generation the German, Scandinavian, Russian, and Italian immigrants. Your true New-Englander is not a prolific father, like the German or the Irishman; and I believe myself that the proportion of Anglo-Saxondom in the America of our day has been grossly overrated. "Anglo-Celtic" is perhaps the truest description of the British nationality.

One of the greatest surprises of modern discovery in ethnical and linguistic science is similarly the overthrow of the Great Chinese Fallacy. Time was when the remote antiquity of China and Chinese civilization was an article of faith for European scholars. It was believed that the yellow man had developed his own culture, such as it is, independently for himself, in the far east of Asia. He was the pioneer in writing, printing, and the use of gunpowder. But now Chinese scholars have shown us, alas! that China really derived its civilization, like all the rest of us, by indirect steps, from Babylonia and Egypt. M. Terrien de Lacouperie first demonstrated the fact that long before the ancestors of the Celestial race reached the middle kingdom which they now inhabit, by the Hoang-Ho and the Yang-tse-Kiang, they lived in close contact with that ancient civilized people, the Akkadians of Babylonia. From the wise men of Akkad they learned the rudiments of their arts; and when they set forth from Mesopotamia, a little horde of Bak tribes, on their long journey eastward, they carried with them both the early elements of Akkadian science, and the words and phrases of the Akkadian language. They reached China with letters, astronomy, and arts ready made, and

they have done little since but live on the traditions of their far-western ancestors. The truth is, for the eastern hemisphere at least, there is but one civilization, which began in Egypt and the Euphrates Valley, and spread in either direction, eastward to Persia, India, and China, or westward to Asia Minor, Greece, Italy, and the Atlantic.

Even the Chinese language turns out, on examination, to be just the opposite of what earlier investigators thought it. Elder philologists took it for granted that primitive tongues *must* have been monosyllabic; and since Chinese is monosyllabic, they regarded it, somewhat illogically, as therefore primitive. But Terrien de Lacouperie and Douglas have shown, on the contrary, that Chinese is really Akkadian by origin, and that it was once polysyllabic, like most other languages. Its words have been shortened by wear and tear, or by that familiar process which turns omnibus into "bus," photograph into "photo," and bicycle into "bike." It consists of words said "for short," like the common abbreviation of William into Bill, Richard into Dick, or Theodore into Theo; or rather, it has suffered by that imperceptible phonetic change which has reduced *eleemosyne* to "alms," *semetipsissimum* to *même*, and Aethelthryth to Awdry. In fact, it turns out that Chinese, instead of being one of the most primitive languages, is really one of the most worn and degraded. In place of "psychology" it would content itself with *psy;* while *tel* or *pho* would do duty for "telephone."

In this case, the diffusion of a language and a culture is by simple migration, as in the well-known instances of Tyre and Carthage, of Greece and Sicily, of England and America. In other cases, the diffusion is rather by conquest, as in the equally well-known instances of Alexander's successors, of the Roman Empire, and of the Arabs in Egypt, North Africa, and Syria. Greek, Latin, and Arabic, with their accompanying arts, became naturalized among the subject peoples. Most often, it is the conquerors who thus impose their language on the conquered; we need go no further afield than Wales or Ireland, where the process is incomplete, and Cornwall, where it reached its termination a century ago. But sometimes it is the conquered who absorb and assimilate the conquerors; the Normans seem to have been good hands at thus losing their identity wherever they went; for in Normandy, they dropped their native Scandinavian and adopted old French; while in England again they lost their French, and in a few generations became thoroughgoing Englishmen. In Ireland, too, as an Irishman expressed it, they "inculcated Celtic habits," and gave rise to the famous saying, so often repeated, that they were "ipsis Hibernis Hiberniores."

On a large scale, this absorption of the conquerors by the conquered appears to have gone on over the entire Malayo-Polynesian

region. It is curious that over this wide area from Madagascar to Hawaii only one type of language is spoken by the remotest islanders, belonging to all races, and having attained the most varied degrees of culture. The black and woolly-haired Melanesians of the South Pacific Islands, the warlike Maories of New Zealand, the gentle, brown Polynesians, the yellow Mongoloid and Mohammedan people of Java, the dark and half-negrolike Malagasy of Madagascar, all speak varieties of this widely diffused language. At one time it was supposed that the Malays, those active Vikings of the far East, had carried their own tongue to these remote places; but then, as Mr. A. H. Keane has pointed out, Malay itself is not the most primitive, but the latest and most developed, member of the group. It answers to French rather than to Latin; it is like modern Danish rather than modern Icelandic. The truth seems to be, as Mr. Keane suggests, that the language in question is a very old one, originally belonging to the true Polynesians. Before their arrival the Pacific isles were peopled by the low black race whom we call Melanesians. Many of the archipelagoes, however, were afterward conquered and colonized by the lighter and essentially Caucasian people, closely akin to our own, whom we call Polynesians. These white Polynesians intermixed and intermarried more or less with the black Melanesians, remaining relatively pure and light-colored in a few of the archipelagoes, while in others they acquired such an infusion of black blood as made them in time dark brown or copper-colored. They imposed their own speech upon the black people everywhere, exactly as the English have imposed the tongue of Shakespeare and Newton upon the rude American and West Indian negroes. In the remotest and blackest islands, Mr. Keane points out, the oldest and crudest form of the common language survives, just as the ancient Scandinavian of the Sagas survives in Iceland; in the more advanced light-brown Polynesian groups, it has been improved and simplified into a more modernized form, just as in Europe the ancient Scandinavian has been improved and simplified into modern Danish and modern Swedish. Finally, at a still later period, the Polynesian tongue was adopted by the yellowish Mongoloid Malays, who conquered the same region, and who further improved and simplified it into the Malay of commerce, as the Normans did with the English of King Alfred. Unfortunately, however, the languages in the lump are generally called Malayan, after the latest people who adopted them, instead of Polynesian, after their original speakers; which is somewhat the same error as if we were to describe English as the Norman tongue, or speak of Latin, Spanish, and Portuguese as belonging to the French Canadian group of languages.

The fact is, we have to recognize that changes such as those

which we know to have taken place during the historical period also took place in prehistoric times and in unhistoric countries. Just as the English now colonize the coasts of the world, from Australia, Tasmania, and New Zealand, to South Africa, Canada, British Columbia, and Demerara, so the Phœnician and the Malay colonized in earlier times the Mediterranean or the Indian Ocean, and so the Melanesian in a very remote past spread across the Pacific in the frailest of vessels. And just as the Goth and Hun and Tartar swept down in historic times on the Roman Empire or the Asiatic world, so, long before, unknown migrations and unnamed hordes of savages swept down upon Egypt, Mesopotamia, and India. For the historic periods and places, we have documentary evidence; for the prehistoric or unhistoric, we have but the evidence of the existing and resultant arrangements.

Even these, however, tell us a great deal. What, for example, can be more curious than the existing diffusion of that tiny black "Negrito" race, with woolly hair and very protruding jaws, which is now in all probability the earliest surviving variety of the human species? These pygmies occur in Africa as the dwarfs of the forest country, the Akkas, Wochuas, and others, barely four feet high; as the Batwas and Bushmen of the south; and less pure, as the Hottentots. They crop up again in the undersized aborigines of the Andaman Islands of the Gulf of Bengal, in the Negritos of the Philippines, and in the small black Papuans. Hence we are justified in concluding that this widespread half-developed race of dwarfs once covered a large part of the southern world, from which it has now been ousted by newer, bigger, and more developed tribes; while the primitive pygmies hold their own best either in a few remote islands, in a few barren deserts, or else in very dense and pathless forests, through which taller races would creep with difficulty.

Not less interesting than these romances of race as race are the romances of the interaction of race and religion, or of race and culture. For example, the Moors of the towns and of the seacoast in North Africa, largely intermixed as they are with Arab and other Semitic blood, have swallowed Islam entire, adopting not only its religion but also its social order—its polygamy, its harems, its veiling of women. The Kabyles and Berbers of the hills, on the other hand, fairly pure descendants of the old native Mauritanian or Romanized inhabitants, though they have accepted Mohammedanism more or less fervently as a religious faith, have never really assimilated it as a social system. To this day they are practically strict monogamists; their women do not veil, but freely show their extremely pretty and piquant faces; while the family is organized on much the same basis as in Europe generally. In other words, the

racial habit of allowing a certain freedom and independence to women has proved stronger in practice than the law of Islam; the intrusive Semite has not been able to inoculate with his ideas the Hamitic North African. Nor in "Aryan" Persia, again, has the prohibition against wine been so successful as elsewhere; while the native artistic and pictorial spirit of the Persian race has made a dead letter of the restriction against fashioning an image of anything that is in heaven above, or in earth beneath, or in the waters that are under the earth. Race, in short, has proved stronger than religion. For the Persians are Shiahs, not orthodox Sunnis; they have transformed the materialistic tenets of Islam into a mysticism not far removed from that of India or the Buddhists. Who could mistake Omar Khayyam for a mere Mohammedan?

Very similar ethnical diversities of faith may also be noticed in our own islands. The Anglican church, as a rule, has firmly established itself in the more Teutonic and southeastern half of Britain alone. The Gaelic Celts, both in Ireland and the Scotch Highlands, have remained Roman Catholic; the Cymric Celts, both in Wales and Cornwall, have adopted Wesleyanism or some emotional form of Protestant nonconformity. Even in England proper it will be found that the Establishment flourishes best in the Teutonic southeast, while dissent is rife in the half-Celtic north, in the Yorkshire dales, in Lancashire, and in the west country. I may add, side by side with these facts, that poets, musicians, and painters spring most frequently in Britain from the Celtic or semi-Celtic north and west, while they are rarer in the Teutonic or Teutonized south and east. Vocalists, in particular, are very frequently Welsh. Even in London, that vast congeries of mingled races, it is not without reason that nonconformity is led by Cambrians like the Rev. Hugh Price Hughes, and that song is dispensed for us by Mr. Hirwen Jones and Mr. Ben Davies.

Canon Isaac Taylor has pointed out a still more curious cross-division of Europe as a whole, dependent upon underlying racial features. Two main types of skull are generally distinguished throughout the whole historic and prehistoric period—there are the dolichocephalic or long-headed, and the brachycephalic or short-headed people. "The dolichocephalic Teutonic race," says the learned canon frankly, "is Protestant; the brachycephalic Celto-Slavic race is either Roman Catholic or Greek orthodox. . . . The Teutonic peoples are averse to sacerdotalism, and have shaken off priestly guidance and developed individualism. Protestantism was a revolt against a religion imposed by the South upon the North, but which had never been congenial to the Northern mind. The German princes, who were of purer Teutonic blood than their sub-

jects, were the leaders of the ecclesiastical revolt. Scandinavia is more purely Teutonic than Germany, and Scandinavia is Protestant to the backbone. The Lowland Scotch, who are more purely Teutonic than the English, have given the freest development to the genius of Protestantism." And then the intrepid canon, instead of worrying about theological explanations of the fact, goes on to show that the mean cephalic index (as it is called) of the Protestant Dutch is nearly that of the Swedes and the North Germans; while the Belgians are Catholics because their cephalic index approaches that of the Catholic Parisians. If a Swiss canton is long-headed, it is Protestant; if round-headed, it is Catholic. And Canon Taylor accounts (rightly, as I think) for one apparent British exception by saying shrewdly, "The Welsh and the Cornishmen, who became Protestant by political accident, have transformed Protestantism into an emotional religion, which has inner affinities with the emotional faith of Ireland and Italy."

Unless so distinguished a divine had led the way, I do not know whether I should have ventured myself to follow into this curious by-path of ethnology. But, in future, whenever one is tempted to ask one's self the once famous question, "Why am I a Protestant?" the answer will be obvious: "Because 75 is my cephalic index. If it were 79, I should, no doubt, have become a Dominican brother."

How charming is divine ethnology! I have said enough, I hope, to show that it is not harsh and crabbed as dull fools suppose, but teeming with odd hints of unsuspected quaintness.—*Cornhill Magazine.*

EDUCATION FOR DOMESTIC LIFE.

By MARY ROBERTS SMITH, Ph. D.,
ASSISTANT PROFESSOR OF SOCIOLOGY IN LELAND STANFORD JUNIOR UNIVERSITY.

THE need of some kind of education as a basis for every activity is constantly emphasized to-day; but this emphasis is rarely applied to the need of training for domestic life, for which it is usually supposed that any kind of preparation will do. One million six hundred thousand women in the United States are engaged in domestic service, and eleven million one hundred thousand more are married and presumably have some kind of domestic duties. Several writers have called attention recently to the fact that a woman does not necessarily have an instinct for home-making; that while her instinct for the care of children may be strong, yet she may lack the skill to make a fire properly or to mix the ingredients of wholesome food. Or she may be skilled in handling modern kitchen appliances, but may lack the knowledge of the effect of exercise, regular hours,

wholesome food and clothing adapted to climate, upon the future health and mental development of her children. It seems to be only just now dawning on women that domesticity—that is, the care of the household and children—is in itself a profession for which the best training and the fullest development attainable are not too much.

The education of women has tended to develop along the same lines as that of men. The classical education for the gentleman has changed to the general education for the average man, and to the specialized education for the industries as well as for the professions. A similar change is taking place in the education of women, but has reached only the second stage. Those who first insisted upon the value of a higher education for women thought it sufficient that they should have the same opportunities as men. This experiment has been tried now for a generation, and it is found that all women do not need the same kind of training as men any more than all men need a purely classical or a purely scientific education. In other words, individualism is breaking up all the accepted lines of education for women as it has for men. As a result, differentiation of courses within the higher training is demanded to meet the practical needs of a life in which no two individuals can possibly do precisely the same things. The fact that one third of all women in the United States are married sets them aside as needing a peculiar training for their profession.

In domestic life women need at least two things: first, the greatest general culture attainable to enrich the home life and to retain the sympathies of children, as well as to store up for themselves resources in hours of difficulty, loneliness, or sorrow; second, they need an education adapted to the everyday business, especially to the emergencies, of domestic life. No education is complete nor, indeed, of great permanent value that does not teach how to live contentedly and to economize nerve energy. To be contented, one must feel sure that one is in the right place, and must have spiritual and intellectual resources to tide over life's emergencies whose end one can not see. To be economical of nerve energy, one must learn a finely balanced self-control and a large-minded discrimination between the values of competing duties and attractions.

It is a significant fact that of one hundred and eighty-four living children of two hundred and twenty-eight almshouse women, less than one third are self-supporting. One fourth are lost—that is, they have been separated from the mother in one way or another, and she no longer knows where they are. The women themselves give all sorts of plausible reasons why their children do not support them; but the fact is, as the stories show, that nineteen women were cast off by their relatives or children because of their drunken,

vicious, or filthy habits, and nearly as many because their children were ashamed of them; five have quarreled with daughters or grandchildren. These facts show that the home life was defective in those characteristics which tend to bind the family together. In the Elmira Reformatory seven per cent had had a good home, thirty-nine per cent fair, fifty-four per cent poor, showing the preponderance of bad home conditions. In conducting a student employment bureau it was found that there was an undue supply of those who wished to do bookkeeping, typewriting, and clerical work, while there was great difficulty in securing any one who could do mending, plain sewing, or ordinary housework satisfactorily. There was a large amount of this domestic work to be performed in the community, but the young women who were obliged to earn a part of their living in college were quite incapable of doing what was needed. Charity and settlement workers continually testify that the women of the laboring classes lack proper training and skill in making home comfortable and wholesome. Without additional illustration, it appears that women are being prepared for everything else than domestic life—the life which, as statistics show, nearly one half of them are living.

What, then, does the average woman need? In the first place, a thorough manual training. She needs to know how to cook a wholesome meal properly, to put it on the table appetizingly, and to do this with the minimum expenditure of energy. It is one of the most hopeful signs in elementary education that kitchen gardening and household training are being introduced into those schools which the children of the general population attend. The need of this practical domestic training for girls has probably been sufficiently emphasized, but in the general readjustment of occupations and duties going on between men and women, it is more and more apparent that boys as well as girls need a certain amount of elementary domestic training. It is a mere fetich, for instance, that women should do all the mending or even have all the care of children. There are many families in which family happiness, comfort, and prosperity would be greatly promoted if the husband and father could, at least in an emergency, take a competent share in the routine work of the household. There are many generous and kindly husbands who would be glad to help, but who are incapable through lack of elementary training. Since the bearing and rearing of children is the most important function of women, the mother must be relieved, at least at times, from many of her ordinary household cares. If there be not money enough to hire extra service, it is inevitable that the father should take, at least temporarily, some of these duties, if the family is to be maintained in comfort.

Again, the average mother needs a thorough grounding in elementary physiology and hygiene. Five per cent of all children born in the United States die under five years of age. When this occurs, the waste of human energy both before and after birth is something appalling. Prof. A. G. Warner estimates that it costs about a hundred dollars in loss of labor on the part of the mother, in doctor's bills, medicine, and nursing, to bring a child into the world, in a laboring-class family; while in families where a higher standard of living prevails this may amount to hundreds or even thousands of dollars. From a purely economic standpoint it is of the utmost importance to society that a child which costs so much, not merely in money but in vital energy, should be reared to maturity. The appalling mortality of children that are born fairly normal and vital is chiefly to be accounted for by the ignorance of mothers. The average woman may not need to know how many bones there are in the body, but she does need to know the connection between rich gravies, indigestion, and bad colds. She may not need to know how to bandage a broken arm, but she does need to realize the effect of sudden changes of temperature upon the delicate infant organism. The value of applied physiology in preserving infant life and diminishing hereditary and individual disease can not be overestimated; and no woman is fit to be married who has not had a training which gives her the elements of this essential knowledge.

Finally, women need a training in ethical standards. One of the curious anomalies disclosed by the entrance of women into industrial life is that while they have higher standards of purity than men, they frequently have much lower standards of honor and honesty. They do not hesitate to outwit, deceive, and "manage" difficult husbands; they train children in dishonesty by continually violating the most common standards of sincerity and directness. Children learn far more by example than by precept: the mother who continually promises, but always finds excuses for not performing; who threatens, but does not punish; who suppresses the child's frank comments on evil actions in others, while herself gossiping about her neighbors; who pretends to dress and to live above the scale of the family income, gives an education in dishonesty and sham which can not be overcome by any amount of so-called moral training.

If to all these practical and utilitarian attainments the mother can add the graces of culture in music or art or literature, she may give the child a background for education and a resource in life beyond the power of statistics to estimate. The elevation, enrichment, and sweetening of the family life by these contributions from the mother's own storehouse of culture are a safeguard against temp-

tation from without not to be matched by legislation or training, nor even by church influence. To make the household sweet, wholesome, dignified, a place of growth, is certainly a profession requiring not merely the best training, but a specific training adapted to these ends.

SUPERSTITION AND MAGIC IN CAMBODIA.

By M. ADHÉMARD LECLÈRE.

THE Cambodians are superstitious, and believe in ghosts, familiar spirits appearing as Jack-o'-lanterns, were-wolves, benevolent and malevolent genii, and demoniac possessions. They believe, too, in witches and diviners, evil-minded persons, who take advantage of what they know to make ill or damage whom they will, or drive a good trade in love philters and antidotes. The people are afraid of these uncanny persons, and yet they sometimes resort to them.

The ghosts are very much like our own ghosts, and when displeased with their still living friends annoy them with noises and mysterious breakings, but are seldom seen. Much in their behavior, however, depends upon the kind of persons they were in life. Some of the more evilly disposed kind enter the bodies of people and render them ill, when a *thmup*, or ghost-disperser, is sought who knows the special prayers and exorcisms that will drive them back to their tombs. It is said that most ghosts will cease to return when the last part of the flesh of their bodies has been decomposed, but some persons assert that riddance of them is not assured till the last particles of their bones have disappeared.

The Jack-o'-lantern spirits are much more mischievous than the others because, I am assured by one of the *literati*, they are ghosts of women who have died pregnant, and are affected by the disappointment of the child at not having been given the privilege of a worldly existence. Both kinds of ghosts are liable to bring with them fever, cholera, dysentery, and other diseases, and, penetrating the bodies of persons on whom they desire to be avenged, leave their ills there. They often resist the efforts of the exorcists for several days, and do not seem to comprehend the special prayers that are directed against them, and some refuse to go away till they have brought on the death of the person whom they have possessed. They sometimes also amuse themselves by misleading travelers. They change the blazes on the trees and break branches of the bushes in the forest paths, so that the wanderer can not tell which is the route he had marked in the same way, or they will call him aside and

lead him into the swamps. Many persons, mistaking their light for that of a house, have thus followed them and been lost.

The approach of spirits menacing a household is announced by the hooting of the owl, "that hungry wild bird of the night with a cat's head and eyes," that scents death from afar. Then mothers tremble for their children. I have seen, in remote farmhouses, fragrant torches placed around the cradle, while the frightened mother stood with folded hands watching. Her fear ceased as soon as I came in, because she had a *parang* with her and was safe—for the Cambodians believe that these evil spirits keep well away from all places where Europeans dwell.

A more terrible and powerful class of spirits are the *arac*, or demons, who take possession of a body and bring death and madness to a whole family. Sometimes, to get more complete possession, the demon takes away the proper soul of the possessed, and hangs it on a tree, where it has miserably to wait for its reincarnation. The possessed ones behave very much like the hysterics of the sixteenth and seventeenth centuries, suffering violent convulsions, and accusing this one or that one of having bewitched them.

The genii are as much feared as the demons, although they are regarded as being good; but as they have also the reputation of being just, they inspire dread, because one can never know when he may have given offense. They take possession of particular places—of mountains, forks of roads, roads, and rice fields—as their protecting and avenging spirits; and numerous spots are regarded with peculiar awe on account of their abiding there. The distinguishing trait between the demons and the genii is that the demons are always bad because they are never good, while the genii are friendly or hostile according to the character of the persons they are dealing with. The former are of infernal, the latter of human, origin. The genii are ancestors passed into oblivion, who, having no longer to watch over their direct descendants, watch over the whole country, over the Cambodian people, and are guardian angels of the nation, as the ancestors are the guardian angels of the family. The Cambodians see in them justice and often counselors to the people.

It was believed, according to an old tradition, that Buddha was to reappear before the year 1888 passed away, and the prediction threatened woe to those who did not prepare the ways. Taking this to refer to the roads, and to mean they should be prepared for the holy saint as they were for the king when he traveled, the people set themselves at work upon the required improvements. Stakes would be found in the morning, driven by no one knew whom, in places where they had not been, when men, women, and children would come out with shovels and hoes to remove the earth, and baskets to

carry it away. In some places the bonzes, who were certainly not ignorant concerning the stakes, directed the workmen, and had the roads made straight to their pagodas. The Chinese and Malays do not escape the road-making fever, and while I was French resident at Kampot I heard some very curious stories of men who were mysteriously struck down for ridiculing or opposing it. At one place a Malay questioned the utility of the work. "What do we want of roads?" he said. "We have always got along without them; this is a French idea." His fellows warned him to look out, or harm might come to him. He went home, and in a little while cries were heard coming from his house. His neighbors went in and found him lying on his side, with his arms stretched out, crying: "Untie me; take a knife and cut the ropes from my arms; cut them and let me work on the road! I have been bound because I spoke ill of the genius." Without a smile, one of the neighbors took a knife and made a gesture of cutting the invisible cords that bound the arms of the unhappy man. He rose, shook his arms to get the stiffness out of them, and went to work on the road. Nobody doubted that he had been bound by a road genius. When I ordered a road built between Kompong Bay and Mac Prang, the Malay under-governor, who was hostile to the project, did nothing toward carrying my orders into effect, till one night a genius appeared to him and ordered him to proceed with the work, because Cambodia must have as broad and fine roads as Paris. He set his gangs to work the next morning.

The witches are not willing to confess to the possession of mysterious powers, because they are afraid of the courts and of popular prejudice; but they may be known by their strange appearance, their bright, lively, black eyes, and restless demeanor. "A witch," I was told, "is always looking anxiously around, because she always has her devil with her." Some witches acquire their standing by imitation, but more by inheritance. The daughter of a sorceress, even if she does not practice her craft, and is not acquainted with its secrets and magical formulas, is supposed to be possessed of a fatal power of which she can not be deprived. She casts the evil eye and terror about her, and her neighbors fear and despise her.

A woman sixty-two years old, who had worn irons on her feet by order of her governor for more than a year, was sent to me, charged with sorcery and the evil eye, although no mischief could be laid up against her. To justify his course the governor said he apprehended that the people would treat her cruelly; but he was really as superstitious as they, and was afraid of her power. The governor of another province refused to take her as a servant when she asked him to, because he was afraid for his family. The interpreter of the residence, a Roman Catholic of Khmero-Portuguese origin, re-

fused to take her home at my request, because of her lively eyes and fear for his wife. A niece, who probably knew more about the unreality of her powers than the governor and the others, at last agreed to take care of her. She told me that her ancestors were reputed to be sorcerers, but she knew nothing about the art, and had never practiced it.

There are other sorcerers who pretend to be acquainted with the demoniac science, and make a trade of it. They sell love philters and magic formulas that will compel the passion; potions that will produce abortions; poisons and more or less effective remedies; and fetich strings that will keep devils and ghosts away. All Cambodians, even the king, believe in them. We need not ridicule Norodom and his countrymen for this, for I have found instances of like weakness among Frenchmen.

Amulets play a prominent part in Kmer life. Besides the cords that keep away evil spirits, they have small cylinders of lead or tin with a cotton or hempen cord running around them, to preserve them against certain diseases; and usually they contain an inscription in Pâli, and a mysterious invocation. Soldiers wear pieces of white cotton cloth marked with arabesques and letters and figures, for protection against death and serious wounds. A lover who repeats nine times the words *Setthi théa jac juc tas ae pac kai sang khac annamac* into a pocket handkerchief he intends to give a young woman feels certain that he will win her love. Another way of securing the love of a woman, however indifferent she may be, is to write her name on a betel leaf and pronounce upon it four times, before taking it into his mouth to chew, the words *Oru chéa sac rat svahap.* The sorcerers also sell marvelous invocations to augment the love of a spouse who is too cool, to prevent jealousy troubling the peace of polygamous households, and to cure slaves of the disposition to run away. They have, too, formulas to cure the bites of scorpions and snakes, to drive rats and mice away from granaries and sacks of paddy, to dispel sorrow, and to make their persons plump.

Many secrets have been lost in the course of time. I was told that there were formerly sorcerers who could travel through the air astraddle of a broomstick or of a porter's rod. The *Maha Rusey,* or hermits of the Satras, are represented as having been able to ascend in the air and penetrate everywhere, to bewitch arms, to manufacture amulets, and render their friends and adepts invulnerable. The modern sorcerers, who have succeeded the *Maha Rusey,* are much less powerful and less skillful. There are said to be sorcerers who even make wax figures to which they give the name of a person they wish to hurt or kill, and then stick with a knife, pronouncing magical words at the same time, when the

person represented by the statuette is supposed to be wounded in the same way. Others, having made and named the statuette, put it where the sun will shine upon it, and as it wastes away in the heat the person represented by it declines, until, when it has all melted away, the person dies—very much like a Western form of enchantment.

Another form of sorcery is beating a buffalo hide with an enchanted stick, pronouncing a magic formula the while, to cause the hide to shrink till it is invisible. It is then ordered to enter the stomach of the victim of the spell, and obeys, when it swells out again till the victim is killed. Yet, if the stomach is examined after death, nothing will be found in it, because the hide has shrunk again to nothing.

These sorcerers pretend to cure diseases. When they are called for this purpose, the first thing looked after is the day when the malady developed itself, for each of the spirits has its special day for appearing, and it is important to know which of them is to be driven away. The "doctor" hardly looks at the patient, for he is of no account in the affair, and the spirit is all. He molds three rude statuettes with rice dough, and puts them in a small box made of a single piece of banana bark, and by the side of it ten leaf packages containing food. A wax candle is attached to one side of the box, and a fragrant stick to each corner. The exorcist then takes an areca knife, and with it touches the forehead at the root of the hairs three times, saying in Cambodian: "One, two, three (*mé keo, mé kot, mé chan,* or *mé si*). Come out of this body, go back to your country, so that this sick man may be no longer ill." He lays the knife by the side of the patient, takes the banana-bark box, goes out of the house toward the south, crosses the yard, and throws the box over the fence or the hedge. He returns, declaring that the evil spirits have gone home and the man is cured, and recites a prayer in Pâli. If the patient fails to recover, they say the spirit has refused to obey, and begin the performance again after two days.

The sorcerers are also fortune tellers. In one of their methods they use a tablet containing twelve figures arranged around a square. The figures are the tower, the silver parasol, the royal dragon, the silver house, the golden house, the dragon that causes eclipses, the golden parasol, the angel, the man with his head cut off, the doctor, the witch, and the man's head without a body. When consulted, the honorable prophet sets his tablet before him, so as to have the numbers 1, 2, 3, and 12 at the bottom. Having ascertained the sex and age of his consultant, he counts up and refers to the figure on the tablet supposed to correspond to them. If he does not know by heart the prophecies which he is to draw from each figure, he

can find them in his satras, reading somewhat after this fashion: "If it is a man that consults you respecting his future, he will be a mandarin; if it is a girl, tell her she will be married before the year is over. If it is a man who wants to marry, he should be told likewise that he will find a wife within a year. If you are consulted concerning a lawsuit, inform your client that he is protected by a powerful man who will see that he wins it. If a sick man consults you, give him to understand that his illness is not serious, and that it comes from his having offended some power, or from not having fulfilled a promise." All this is not very hard. But the satras containing these revelations and prophecies has lost much of its importance in recent years. It has been stolen, and several copies have found their way into the hands of the *sachars*, who have very little faith in it. I have, however, seen a *literatus* consult it seriously, and have heard several persons affirm that it is infallible.

This business is innocent trifling, and the prophecies are not of the kind that lead the seers who sell them into the courts. It is not for predicting good fortune that they are sometimes condemned to death, but for real crimes committed under color of sorcery.

Loup-garous are victims of witches, who cast a spell upon them or cause them to absorb some magical essence. They leave their homes in a state of insanity, fly to the woods, climb trees, or hide in the thickets. They are followed by tigers, who wait till the seventh day, when the hair has grown upon their bodies, and then take them away into the forests to live by hunting. There are stories of women transformed in this way, who have become terrible tigresses, living wholly on human flesh. When a person is afflicted in this way he must be pursued with a pole and struck very hard on the head before the seventh day, the pursuer uttering magical invocations. Then he can be taken home well or convalescent.

It appears from this that Europe has not invented its magic, and that the superstitions which have prevailed there for generations of wizards and witches, ghosts, familiar spirits, *loup-garous*, love powders and philters, amulets, secret cures, love formulas, magical incantations and exorcisms are also to be found in Cambodia.—*Translated for the Popular Science Monthly from the Revue Scientifique.*

THE report of the Clerkenwell Public Library, London, for 1897, represents that scientific works are very largely circulated. Biology, including evolution and methods of scientific research, is a very popular subject, the sixty-eight works on it which the library contains on this topic having been issued twenty-eight hundred times during recent years. In this subject two copies of Darwin's Descent of Man have been issued nearly two hundred times, a record which is exceeded only by the most popular novels.

THE TRAINING OF MENTALLY DEFICIENT CHILDREN.

By MARTIN W. BARR, M. D.,
CHIEF PHYSICIAN, PENNSYLVANIA TRAINING SCHOOL FOR FEEBLE-MINDED CHILDREN, ELWYN, PA.

A CORRECT classification is of paramount importance in the work of training the feeble-minded.

We *must* have some clear, positive standard by which we are to discern and separate the unimprovable from the trainable, lest we deceive the public by false hopes and accept those for whom we can do nothing. Again, the necessity for much individual work—the varied capacity of those to be trained, and the impossibility of bringing all up to one common plane—necessitate the arrangement of grades in which very different means of development may be employed to attain very different ends.

Guided by these needs, therefore, we have adopted a nomenclature dictated by experience as essential to the practical work of training, and which is also in accord with the anatomico-physiological demonstrations of scientific investigation.

This gives, broadly, two classes—the imbecile, trainable, and the idiot, unimprovable—which, modified, stand thus:

1. The imbecile—trainable in three grades: low, middle, and high.

2. The moral imbecile—found in all these grades; trainable only under rigid custodial care.

3. The idio-imbecile—improvable as regards cleanly living, and trainable in a very limited degree.

4. The idiot—except in rare cases and by expensive methods, absolutely unimprovable.

The imbecile, the only trainable class, divides into low, middle, and high grade. The first of these may be brought to give, always under direction, fairly good service for farm or house, if training be begun early, before apathy or indolence becomes a settled habit. He rarely if ever learns to read, and very soon reaches his mental limit. The imbecile of middle grade is capable of making great progress in primary-school work. I might say in about four years, especially if he has had previous training in the kindergarten, he will attain some proficiency in reading, writing, and number work, together with such a knowledge of form, color, and practice in free-hand drawing as shall materially aid him in learning a trade; indeed, mental development for him is best attained through simple handicrafts having their initiative in the kindergarten.

The high grade shows children but slightly mentally deficient, who progress slowly as far as the ordinary grammar-school grade,

frequently developing an aptitude for music, drawing, and the various industries. These are the backward children that the schools complain of—the "feebly-gifted" ones of England, the "*tardivi*" of Italy, "*les enfants arriérés*" of France.

These are they so often not recognized in seminary or college life until under excessive pressure or the excitement of competition comes complete breakdown—idiocy, insanity, or early death.

So nearly normal are many of these that their defect would perhaps be noticed only by the initiated, and the question is often asked, "Why are these who do so well accounted feeble-minded?" the public little knowing that the time and labor have been double those expended for like results with a normal child.

The moral imbecile, generally of high or middle grade, quick of apprehension, crafty, and cunning; or, if of low grade, sullen and cruel often to brutishness, absolutely destitute of the moral sense—what might be termed ammoral or unmoral—is too dangerous an element to be permitted in the schools. This, the saddest victim of a fatal inheritance, is he who claims most at the hands of society and who gets least, because, precocious and often abnormally bright, he is, as a certain jurist once delighted in saying, "the kind we hang." As intellectual training does but add to his armament of ill, for him should be provided, within strongly guarded asylum walls, all the benefits of a manual training school and its outcome in the various trades, which shall at once give vent for his superflous energy and render him self-supporting; but this should be coupled with all the ameliorations of cheerful living that humanitarianism owes to this scapegoat for the sins of others.

Hard labor and lifelong sequestration are the only medicine for his ill—a disease too often due to the sins of a normal ancestry.

The idio-imbecile, who, as the name implies, partakes of the nature of both the idiot and the imbecile, is generally undersized, with very defective speech, and a limited vocabulary confined to a few scattered words, never a full sentence. His improvement is but limited. The most we can hope to do is to keep his nervous, restless fingers employed. He can sometimes learn to knit, to weave mats, or do simple housework, but never to read or write. For him, as for the idiot, but little can be done beyond giving the custodial care best adapted to his peculiar needs, the *genuine* benefit being found in the family relieved of such a burden, as it has been computed that for every case sequestrated, two if not four normal persons are released to society.

The idiot is usually but poorly developed, in most cases unable to stand or even to sit alone. Hardly conscious of his physical needs, he has no language but a cry. He rarely learns to talk; indeed, in

all my experience of idiocy do I recall but two: of these one, after much effort, was able only to speak his brother's name, and the other acquired three words in three years.

A teacher endowed with originality in devising means, versatility in presenting so as to avoid monotony, gentleness and unwearied patience in constant repetitions, possessed of that fine perceptiveness and devotedness to her vocation that shall enable her to note improvement imperceptible to a layman—all these valuable qualities combined with good physical condition (which alone can insure that tenderness and firmness giving power of control over herself and the child)—*may*, in years, raise an idiot to the plane of an idio-imbecile, enabling him to do perhaps the work of an idio-imbecile—an aid in the care of his associates. But is it worth it—more especially when, while we are raising the idiot to this, we are shutting our doors upon hundreds of idio-imbeciles who are lapsing into idiocy for lack of these very occupations which alone can keep them from retrograding? Will not history stamp such an act as in itself most idiotic, second only to that other of carefully *guarding* the comparatively *harmless* idiot and turning loose the moral imbecile, a firebrand upon society to desolate homes or to transmit his moral leprosy to generations?

The absurdity, therefore, of placing unimprovable idiots in a training school is self-evident. Yet willful misrepresentation on the part of a sensational press, coupled with every influence that mere sentimentality can bring to bear, is daily burdening our work with an element fit only for asylums, and crowding out the improvable imbecile who can in time be so trained as to enable him, under constant care and supervision, and with proper facilities for control, to become almost self-supporting—this, too, in a life freed from anxious care, and, what is of the first importance to society at large, a life freed from temptations, from opportunities for crime, and from the power of transmitting ill. *Always* under guidance, *always* under control, this "child"—who never attains the full measure of maturity—must ever be, lest his unconquerable indolence or his lack of will power make him the slave of vice, the victim of poverty and wretchedness, or the tool of the designing and the wicked.

So much for aims and means. A word further as to methods.

These, based upon the theories of physiological education dictated by Pestalozzi, Froebel, and Rousseau, first successfully practiced with mental defectives by Itard and by Seguin, include all the means that modern thought and experience have gathered.

Kindergarten, Nature studies, object lessons, sloyd, and the many occupations included under the name of manual training, all lend a successive and continuous stimulus—the one underlying principle

and aim of the schools being to induce observation and comparison as a basis of *thinking* and *doing*.

Calisthenics and military drill induce physical development and muscular co-ordination, quick observation, and prompt subordination. These vital principles of physiological education have practical and intellectual application in the exercises in freehand drawing, modeling in clay and wood, in sloyd, in basket and straw braiding, and in the phonetic and articulaton drills and musical exercises of the classroom, each being the initial of a lifelong occupation. Believing as we do that "the working hand makes strong the working brain," there is always something for the child to do, some object to be made; not an abstract thing to be put out of sight when finished, but something of use to himself, or to one for whom he cares. Work constantly stimulated through the emotions is his, all along the line from kindergarten, classroom, and sloyd, to shoe shop, printing office, and other useful trades. Should his limit of application be soon reached, and the avenue of happiness and safe living be for him reduced to one single groove, the more active pursuits of the farm, the garden, laundry, or household service will interest and provide vent for superfluous energy or by constant stimulus keep him from retrograding or lapsing into apathy. For these varied occupations he is all the better fitted by the previous training of the senses received early in the schools, and if happily he should have there learned to read or draw, to color, to carve, or has acquired any skill in music, he will have many avenues of recreation closed to his less fortunate brother, to whose comfort and pleasure he himself will be the better able to minister.

All this we can do and are doing in our training schools, both here and abroad, in spite of being handicapped by the burden of the idiot, the care of the moral imbecile, without adequate accommodation, and by frequent loss, from one cause or another, of trained workers just as they become useful members of the community.

The possibilities for the trained imbecile have not, therefore, yet been made clear on account of this diffusion of energy, nor his true sphere recognized, mainly because of the *false idea of cure* which is continually being presented to the mind of the public.

Worse than foolish is the idea that training can prepare even those of high grade to battle with the world or fit them for any life outside of institution walls.

Animal propensities, weak wills, sluggish or excitable temperaments, characters utterly abnormal, will inevitably drift in large numbers to swell the insane or the criminal ranks; and it may not be out of place for me to say that from the standpoint of the alienist,

criminal procedure against such irresponsibles, especially those in that period of adolescence when most susceptible to suggestion or to nervous excitations, is not less reprehensible than was the delusion regarding witchcraft in a less enlightened period of our history.

THE GENEALOGY OF CHEMISTRY.

By M. E. BERTHELOT.

MODERN science is the child of ancient science—that is, of Grecian science; for it was the Greeks who constituted science under the form which we recognize now. Before the Greeks no really rational science existed, free from mystical and priestly attachments. While astronomy was cultivated in Egypt and Chaldea, it was at first with the object of determining the times of the religious festivals and of keeping agriculture correlated with natural phenomena; and next for the discovery of the mysterious connection which astrology predicated between the positions of the stars and public and private events, under the belief that the life of men and the development of phenomena were determined by the fatality of the sidereal influences which presided at their birth or origin. Geometry and mechanics made considerable advance at Babylon, Thebes, and Memphis, being applied to the measurement of the lands and the construction of buildings, as is attested by the study of the indestructible monuments of ancient Egypt; and the equilibrium of the Chaldean structures of brick, now in ruins, required knowledge of the highest quality, yet more developed, perhaps, than that of the Egyptians. But both peoples always accompanied their work with prayers and magical invocations. The excellence of the processes of ancient times in the treatment of metals, pottery ware, colored glasses, and dyed cloths, with which experimental science is now very busy, is demonstrated by the relics of ancient civilization which we have collected in our museums. The old alchemical manuscripts tell us that these practices were explained in the Book of the Sanctuary of the Temple. The origin of medicine was traced to the temples, and this was not an empty metaphor; for the temples were the repositories of all knowledge in the East, and even to-day all Mussulman instruction gathers round the mosques. But the members of the old priesthood never imagined that it would be possible to separate the double part they were playing of priest and scientific student. They combined scientific practices with prayers and religious rites, the performance of which was deemed indispensable to the success of the processes. The idea of a

miracle granted by the favor of the gods, and, if necessary, imposed upon their will by the formulas of magic, was held inseparable from the secret action of natural forces. The Greeks dissolved this connection of ideas, and founded, in the sixth century B. C., rational science, stripped of mystery and magic, as it is now current among us. The Alexandrian period witnessed the triumph of the new method; when astronomy was fully disengaged from astrology, geometry separated from the ancient rites of the field measurers, medicine and surgery rid of pilgrimages and superstitious practices, and chemistry rendered independent of the incantations by which it was thought the success of its manipulations could be assured.

This took place, in principle at least, with the most enlightened minds. But the mysterious and charlatanish part of these sciences, and their association with mysterious prayers and invocations, did not disappear all at once. They persisted in antiquity, and even acquired new favor as the ancient culture fell into decay; they were held in honor during all the middle ages, and still rule in the East.

European science has gradually, since the sixteenth century, regained the firm tradition of the Hellenic philosophers. It has rid itself of the old train of dogmas and chimerical operations, and has pursued steadfastly the construction of the edifice founded by the Greeks. While the accumulated work of generations has raised it to a height not dreamed of by the ancients, and while it has extended its dominant applications to all branches of the social organization, we still have no right to say that our methods and our modern spirit would be rejected by Archimedes or by Aristarchus of Samos. On reading our works they would recognize their legitimate heirs.

There was, however, an interval of sixteen centuries between Grecian science and that of the moderns, during which no transmission of facts, ideas, and methods took place directly, but it was effected through intermediaries of less stable minds, who were imbued with the ancient prejudices. Hence arose a mixture of pure reason and mysticism, which dominated science toward the end of the Roman Empire and during all the middle ages. By virtue of this association of two contradictory elements, now become irreconcilable, Greco-Alexandrine science took on a strange figure at the beginning of the Christian era, when the pure rationalism of Democritus, Aristotle, and their earliest disciples had declined. Hence that curious amalgam in which the positive notions of genuine chemistry were confounded with the contradictions of gnosticism and the survivals of the religious traditions of ancient Egypt. This mixture lasted longer in chemistry than in any other science, and it was not till the end of the last century that chemistry was completely freed from these singular ideas and constituted under a purely scientific

form. The long history of its successive advances and its systematic tentatives, in both the practical and the philosophical departments, is most remarkable.

In the period that followed the Alexandrine epoch and preceded the definite recognition and naturalization of alchemy in western Europe, in the thirteenth century, the name of the Arabians is predominant; and the most widely known authors usually ascribe to them the progress which the Greeks made in most of the sciences. They have sometimes even gone so far as to attribute to the Arabs the discovery of chemistry—a view which has to be abandoned on obtaining an exact knowledge of the original authors.

I have devoted nearly ten years to the study of this subject, and have published for the first time the texts of the Grecian chemists, as well as those of their Syrian and Arabian followers, drawing them from their hiding places in the libraries of London, Paris, and Leyden—works which no one would read, because they were supposed to be chimerical and unintelligible. Yet there is a real and profound science in these old texts, mingled, it is true, with erroneous notions concerning the transmutation of metals, and with illusionary and often charlatanish pretensions.

Except gold, which has been mined native from the earliest times, pure metals are rarely found in Nature. A native alloy of gold and silver is found in similar conditions as gold, which was called white gold or electrum by the ancients, and was considered a separate metal till the sixth century A. D. It was used as a material for money by the Lydians, and by the Grecian cities of Asia Minor, till near the time of Alexander. This alloy, however, has no constant properties, for the relative proportions of its two components are variable. By reason of this diversity it had an important place in the thought and attempts of the alchemists seeking for the transmutation of metals; for we can extract gold or silver from it at will, according to the treatment we give it. Hence the opinion that electrum was susceptible of being changed into one or the other of these two noble metals.

These notions and experiments were confirmed by the metallurgical methods employed in the fabrication of other metals. Iron, copper, lead, tin, and silver do not exist as such in Nature except in unusual minerals. They are ordinarily found in oxide or sulphide compounds, and are, when separate, products formed by human art. In fact, it is by submitting these compounds to more or less complicated reactions, in which fire, combustible agents, drying, or roasting in contact with the air are applied, that the different metals are prepared. These preparations were formerly made according to a traditional empiricism, the origin of which is lost in the

night of the ages. It has hardly been more than a century since chemists first succeeded in accounting for the reactions and in improving upon them by the aid of more precise notions founded on the theories of modern science; and our own age has witnessed a still more radical transformation in metallurgy resultant upon the discoveries in electro-chemistry. But everything rested, in antiquity, upon empiricism, unguided, except by vague analogies.

The metals which the ancients thus obtained and made use of were not always pure metals. The ancients had a number of varieties of copper and of lead. First, a distinction was made between black lead and white lead; the first being our modern lead, while the second has become our tin. These names were, however, applied to other metals and alloys, including antimony, which was obtained by roasting and reducing its sulphuret, under conditions which are described by Dioscorides; and some alloys of silver originally designated by the name of *cassiteros*, which was afterward applied to our tin. The *stannum* of Pliny also has this double meaning.

The white alloys, of brilliant and little changeable surface, were given a special name—*asem*, or Egyptian silver—a name which was continually reappearing with the Greek alchemists, and was confounded with the name of silver without definite title—*asemon*—a designation which was given to very diverse substances, from pure tin to electrum. So it was with the metal called *chalkes* in Greek, *aes* in Latin—a name which included innumerable species; whence modern translators use indifferently the words brass, copper, and bronze to represent it. Modern pure copper is too soft to be used for forging arms or solid tools, and the Greek and Latin names usually refer to alloys. The ancients had copper of different colors, and specified the species by adjectives derived either from these colors, or from the place of origin of the substance. Thus, they had red copper and Cyprian copper, *aes Cyprium*—an epithet which, in the time of the Roman Empire, became the name of the metal, *cuprum*—besides yellow copper, white copper, etc. Yellow copper in its turn included several varieties, for its composition varied greatly. First, there were the bronzes, alloys of copper and tin, used for many centuries in the manufacture of arms, till they were dethroned by the advances in the manufacture and tempering of iron. In the Roman Empire one of these alloys, which was used for mirrors, was designated, after the name of Brindisium, where the manufacture was carried on, *aes Brundusinum*, whence our word bronze is derived; in other alloys of various shades, yellow or whitish, copper was combined with lead or zinc—a metal which the ancients did not know in a state of purity, but of which they were acquainted with the minerals, natural *cadmies* or *calamies*

as they were called, whence our word calamine. The fusion of these minerals with those of copper produced alloys similar to our brass.

While some of these compounds of copper, by virtue of the importance of their applications, thus acquired special names, there were others among the yellow alloys which, employed in antiquity and the middle ages, have fallen into disuse; compounds of copper with arsenic and antimony, for instance, which were useful for promoting the combination of substances like iron with copper or tin, which would not readily unite with them directly. Modern chemistry has very little to do with such alloys. But an alloy of copper and antimony has been revived and patented within the past twenty years which has the appearance and many of the properties of gold. It was known to the Greek alchemists, and is mentioned in the Syriac translations of their works. There existed, therefore, in antiquity and the middle ages, a multitude of artificial metals, passing under the general names of lead, iron, tin, electrum, and gold and silver. Furthermore, as pure silver was confounded in goldsmiths' practice with various alloys designated under the name of *asem*, so the name of gold was not applied to pure gold alone, but was extended to alloys of that substance with copper and other metals; alloys which differed greatly in richness, but were used for making base goods for which the goldsmiths tried to make their customers pay the price of pure gold. These fraudulent practices and tricks have continued down to our own time in countries where the law has not fixed the standard of merchantable gold and silver with severe penalties for violating it.

With these facts before us we can easily comprehend the ideas and theories of the alchemists, and imagine on what their practices and hopes were based. One of the first ideas their experience gave them was, doubtless, that the properties of the metals varied. The theoretical definition of our simple bodies, which we now know continue unchanged in nature and weight through the course of their metamorphoses, was developed slowly, and was not recognized as a certainty till within a century. The positive minds of the Roman lawgivers no doubt perceived the necessity of employing pure gold and silver, or alloys of a fixed standard, for coinage; but this was a practical prescription, and not a scientific principle. Although the artisans who worked these metals knew how to obtain substances of legal purity, they had no sign to inform them whether these substances really represented a single metal of unchangeable quality, or whether they were dealing with a conventional stage in the undefined series of transformations of matter. These legal divisions applied to gold and silver. There is nothing to prove that any one of the innumerable species of copper, lead, and tin repre-

sented more than another the fundamental state to which all of them bore relation. In short, gold, silver, copper, and lead were really, in the eyes of the alchemists, mixtures or compounds, the properties of which could be modified at will by adding or subtracting certain of the components.

The idea of this fundamental unity of matter was derived from a more remote principle. It was subject to the existence of the four elements—earth, water, air, and fire—from the association of which, according to Plato and Aristotle, all the substances in Nature were constituted. We know now that these ancient elements were not real substances, but symbols of the fundamental states of matter, such as solidity, liquidity, the gaseous and all static conditions; the fourth element, fire, represented a dynamic state of bodies. These symbols had, on the other hand, a really substantial value for the alchemists, a character defined by the approximate identification of their supposed elements with certain products, in which the properties corresponding with one of the elements seemed to reside in a more eminent degree. Modern science has become more precise. At the same time the substantial elements of the ancients have come to be regarded by it as symbols of qualities and phenomena. Still, the Grecian philosophers conceived, behind the elements which were supposed to add their peculiar properties to bodies, an essential unity, residing in a higher degree in indeterminate primary matter; modified by multiple forms and accidents, it concurred in forming all things. The elements, they said, are opposite by their quality and not by their substance. This more general notion did not cease to prevail in the Cartesian conceptions and in those of our own times too.

Such metaphysical views were, however, too vague to furnish the goldsmiths and alchemists a clear explanation of the facts which their daily practice offered them. In this a special state of mind is manifested. Chemistry, indeed, has always had a singular aptitude for creating a sort of materialistic metaphysics, in which the names of beings and of first principles are employed with a restrictive and in a certain way a tangible significance. The Grecian chemists said that the metals were like man: they had a body and a soul. The soul was, however, to most of the ancient philosophers, nothing else than a more subtle matter. The alchemists were thus led to imagine a primary matter, appertaining to the metals alone, which constituted their common essence. It seemed to be indicated by that general condition of fusion which all metals take under the action of fire, in which they are ready to go into alloys and receive coloration and the impression of new properties. The ancient Egyptians regarded lead as this primary matter, and gave it the name of *Osiris*. About the time of the Peloponnesian war a new substance

came under notice—mercury, or liquid silver—which corresponded still more nearly with the idea of the primary metallic matter. No author has informed us concerning the origin of the discovery of this singular metal. We only know that the Carthaginians were at that time working the mines of Betica, and that the minerals of mercury, situated in the same region, were well known and operated in the time of the Roman Empire. At any rate, the appearance and properties of this liquid and vaporizable silver, which was almost as refractory to chemical reagents as its ancient solid homonym, struck the imagination forcibly. It only seemed necessary to fix it—that is, to take away its liquidity and volatility—to obtain the other metals, particularly real silver. Mercury thus became the primary metal of the alchemists. A letter is extant from Synesius, a writer of the end of the fourth century, to Dioscorus, embodying a kind of catechism concerning the qualities and relations of this substance, from which we gather that, being the primary matter of metals, the first essential proceeding was to fix it or make it solid and stable as to fire, like other metals; then to color it, by the aid of some white or yellow tinctorial substance, such as sulphur or the sulphurets of arsenic, by which it would finally be changed into gold or silver. The name mercury had a variety of significations. It represented native mercury, extracted directly from the mines; artificial quicksilver, prepared from cinnabar, which was called copper mercury, lead mercury, or tin mercury, according as it was prepared in the cold by crushing cinnabar in a mortar with copper, lead, tin, etc., when the mercury produced appeared to participate in the qualities of the metal which had been used in its preparation. To us it is always the same mercury, rendered impure, indeed, by some trace of the precipitating metal; but in the eyes of the alchemists there were different metals. Furthermore, the term mercury was applied to two substances which we know were radically different: modern mercury, or mercury extracted from cinnabar, and metallic arsenic, which they called mercury extracted from orpiment. Both are, in fact, volatile and susceptible of sublimation, and both form red sublimates; both turn copper white, and both form red sulphurets. From these particulars we can see how broad was the meaning of the common word mercury, and how the mercury of the philosophers represented a kind of quintessence, common to these various kinds of mercury, or the primary matter of the metals, susceptible of being changed by coloring into gold or silver. The work to be done, then, was to extract this mercury from ordinary metals, and then color it to gold or silver; or to operate on its substance as it was contained in the copper, lead, tin, and iron, so as to eliminate the contrary qualities and perfect the conformable quali-

ties by means of suitable reagents, which would at the same time color it. These coloring reagents were designated, generally, the philosopher's stone.

Governed by these ideas, the Greco-Egyptian alchemists obtained a great variety of metallic alloys, some white and nearly as unchangeable as silver, to which they assimilated them; others yellow, and having a stability like that of gold, of which they gave them the name. Real gold and silver were besides often included in the composition of these alloys, when they were regarded as the seed, and were supposed to multiply, as if they had been living beings, under the action of certain ferments. The alchemists frequently found that their recipes for transmutation were not sufficient to produce gold and silver; that after combining a certain number of properties, others were still wanting; at this point they fell back upon the mystic part of their science. The confusion between real silver and gold and the white and yellow alloys was carefully nursed by the alchemists, who even went so far as to call gold and silver metals which were only superficially colored by the action of mercury and the sulphurets of arsenic, and metals that were only covered with a golden varnish. This confusion of language exists even in the industries of our own times, as when manufacturers speak of the gold of a color or a cloth.—*Translated for the Popular Science Monthly from the Revue des Deux Mondes.*

THE LIFE AND WORK OF FELIX HOPPE-SEYLER.*

By ALBERT P. MATHEWS.

IN the summer of 1895 the world lost two men, each of whom, in his own way and in his own country, had exerted an unusual influence on the development of science. They were born and they died within a few months of each other. Each was endowed by Nature with the gift of seeing the relationship of apparently unrelated phenomena; each passed through a medical training; each devoted time, much against his will, to dissection and anatomy; each was a fighter for what he believed true; each was gifted with a winning personality that attracted friends from all sides; each was a great teacher, having a ready sympathy for young students, and each was remarkable for the breadth of his knowledge and the keenness of his insight. One was Thomas H. Huxley, an Englishman, the other Felix Hoppe-Seyler, a German.

* In part adapted from an article entitled Zur Errinnerung an Felix Hoppe-Seyler. By E. Baumann and A. Kossel. Zeitschrift für physiologische Chemie, Bd. xxi, 1895.

Very similar in natural gifts though Huxley and Hoppe-Seyler were, the different environments under which they were placed determined their development in radically different paths. Huxley, though possessing a strong natural tendency toward physiology, was forced to become an anatomist, and from a very early date his great controversial powers were called into such requisition that his name became almost a household word among the English peoples. Hoppe-Seyler, on the other hand, while still very young, was given a decided impetus toward the study of the chemistry of organism, and, as a pioneer in a new science, was little known outside the immediate circle of his personal friends and scientific colaborers.

Felix Hoppe-Seyler deserves to be remembered by mankind not only for the valuable contributions he made to our knowledge of the chemical processes of life, not only for the impetus he gave to the development of a new science, physiological chemistry, but also for the influence he exerted on the minds of his pupils and colaborers. Great investigator though he was, and lasting though his influence on the development of biochemistry will be, he probably served mankind best in his capacity as a teacher. As there has not appeared in any English or American journal a just account of the value of the life and work of this illustrious man, a brief sketch of one to whom the world in the future will probably consider itself indebted, not less indeed than to Jenner, Pasteur, Koch, and Lister, may be of interest, and some recognition, insufficient though it be, of his lifelong services.

Ernst Felix Immanuel Hoppe, better known as Felix Hoppe-Seyler, was born in Freiburg in Thuringen, on the 26th of December, 1825, and died suddenly of heart disease at his summer home on Lake Constance on the 10th of August, 1895. He was the tenth child of the Pastor Ernst Hoppe and Frederike Nitzsch. He came of a long line of school teachers and ministers. His mother died when he was six years old, and his father three years later. The lad received a temporary home with his brother-in-law, Dr. Seyler, but soon entered the orphan asylum at Halle, where he attended the gymnasium.

His stay in Halle exerted a great influence on his later life, for the *régime* at the institution which was his home was of Spartan-like simplicity and rigidity. He came under the influence here, also, of the old apothecary of the institution, who took great delight in introducing young Hoppe to the mysteries of chemistry, in which he soon acquired considerable proficiency. He was dismissed from the gymnasium as a diligent student in 1846, with a preference for the natural sciences and mathematics, and in the autumn of the same year was matriculated in the medical faculty of the University

of Halle. Here he passed much of the time of his year's stay in the pharmaceutical laboratory of Sternberg.

One of the inheritances he received from his boyhood and which he carried with him to the end was a great liking for an active outdoor life. In the summer vacations he would frequently take long pedestrian tours, and in the course of one of these he met the celebrated Weber brothers, Ernst and Eduard, of Leipsic, with whom there thus began a long friendship. Influenced by his new friends, Hoppe, the next year, betook himself to Leipsic and entered the classes of W. Weber in physics, E. H. Weber in physiology and anatomy, and of Eduard Weber in nerve and muscular physiology. He attended, also, Erdmann's lectures in organic chemistry and Lehmann's in physiological chemistry and pharmacology. In the spring of 1850 he went to Berlin, and the same year took his doctorate, with a thesis entitled On the Structure of Cartilage and on Chondrin. This thesis and Hoppe-Seyler's subsequent work in the same direction, which confirmed previously expressed views of Virchow, attracted the favorable notice of the great pathologist, who thereafter became to young Hoppe a helpful friend.

He was approved as practicing physician in 1851, spent some time in Prague in the study of obstetrics, returned to Berlin, and entered practice. He found little liking for this, and in 1854 was appointed prosector in anatomy in Greifswald, where he became later *Privatdocent*. His personal relations here not proving to be of the pleasantest, and the outlook for the future being anything but promising, Hoppe resolved to go to America, and wrote Virchow to that effect. The latter, however, induced him to remain, promised him a position in his new laboratory, and soon had him appointed assistant. Here his time at first was so taken up by students that he was only able to carry on his chemical studies on Sundays. Again Virchow came to the rescue, had a second assistant appointed, and put Hoppe in charge of a laboratory of pathological chemistry. He was appointed extraordinary professor in 1860, and his laboratory quickly became the center of physiological chemistry in the world. To it came Kühne, Alexander Schmidt, v. Recklinghausen, Leyden, Wilson Fox, Botkin, and many others.

In 1861 he was called to the chair of applied chemistry at Tübingen, where he was shortly made full professor. His laboratory here was of the most primitive description. It was located in the former kitchen of the old castle on top of the hill. The big chimney place, and the spits, were converted into appliances for chemical research. Here began a most fruitful period of Hoppe-Seyler's career; from this laboratory appeared much of his best work. Among the students who gathered about Hoppe-Seyler here were Miescher,

Baumann, Froriep, Gaehtgens, Parke, Salkowski, Zalesky, Löbisch, Tolmatscheff, Polz, Diakonow, Liebreich, Lubavin, Manassien. Here he remained for ten years, until in 1872 he went to Strasburg to take the chair of physiological chemistry, the first and only professorship of its kind in Germany. In Strasburg he spent the remainder of his life, and here, as in Tübingen, many students came to him, among whom were Kossel, Hoffmeister, Neumeister, Frederiq, v. Jaksch, Ledderhose, v. Mering, Mauthner, v. Udránsky, Popoff, Rajewsky, Sokoloff, Howath, Herter, and Giacosa.

In 1864 Hoppe was formally adopted by Dr. Seyler, and thereafter took the name of Hoppe-Seyler. In 1858 he married Agnes Franziska Maria Borstein, by whom he had one son, Georg Hoppe-Seyler, now professor of medicine in Kiel. In appearance Hoppe-Seyler was an erect, vigorous, active man, above medium height. Although at the time of his death nearly seventy years of age, his hair was not yet gray, his step was still youthful and elastic, and he appeared yet to have many years of life before him. He was eminently what the Germans call "*liebenswurdig*"—kindly and sympathetic, especially toward his pupils, whom he made his friends. With all his kindliness, however, Hoppe-Seyler, like Huxley, had little patience with half truths or errors, and he possessed a sharp pen, which, in truly German fashion, told the whole truth about one unfortunate enough to incur his displeasure.

The scientific work of Hoppe-Seyler extended over forty years. His contributions to science are embraced in some hundred and forty-six separate papers. He was the author of a handbook of physiological and pathological chemical analysis, which has had six editions, and is still the best book of its kind extant. In the years 1877 to 1881 he published his celebrated text-book of physiological chemistry, which still remains as a monument to his industry, to the wide scope of his knowledge, his keenness of perception, and his power of correlating facts. Though many of the conclusions contained in the work have been modified by more recent investigation, the book stands unique among similar productions as the most exhaustive treatise on the chemistry and chemical changes of the animal and plant kingdom ever attempted.

The range of subjects in which Hoppe-Seyler published observations, outside his biochemical work, is remarkable, and includes botany, mineralogy, geology, chemistry, and physical diagnosis. He detected the presence of the newly discovered element, indium, in wolframite, and he devised a spectroscopic test for manganese, which is one of the most delicate known, and is still called Hoppe-Seyler's manganese test. Throughout his life he took a keen interest in mineralogy and geology. In 1865 he

made the not unimportant discovery that gypsum, heated with sodium chloride to 130° C., was converted into the crystalline anhydride, and in 1875 he published a series of researches on the formation of the dolomite masses of Germany, which did much to elucidate the problem, indicating, as they did, the formation of dolomite by the action of sea water on calcium carbonate. His works on percussion and the pulse were valuable contributions to physical diagnosis.

In biochemistry his work is remarkable not only for his discoveries, but also for the great number of ingenious methods of research devised by him. Our methods of examining pathological transudations, pus, the blood, are derived in large part from him. He was quick to perceive the value of the spectroscope in the study of the chemical changes in the pigments of blood, urine, bile, exudations, and elsewhere in the animal and plant kingdom, and he applied the method with particular success to the study of the blood pigment and chlorophyll. He seized upon the Soleil-Ventzke improved polariscope as a valuable means of estimating the albumin and sugar contents of urine, blood serum, transudations, and milk. He studied the circumpolarizing action of gelatin and the substances contained in gall, together with their decomposition products. By means of these methods he rendered great service to physiological chemistry.

In the chemistry of the organism he broke ground in a great variety of places, but left the further development of nearly all the paths thus indicated to his students. His earliest work was done upon the chemistry of cartilage and the relation of cartilage to bone, work which bore closely on Kölliker's discoveries on the genesis of bone, and showed the essential similarity, in a chemical way, of the great group of connective tissues, first classified by Virchow.

He made extended analyses of the enamel of teeth, showing its essential identity with the rock apatite, and that the enamel of the teeth of fossil and living animals was identical in chemical composition. During his stay in Berlin he published a number of treatises on the composition of transudates, and later compared the effect on the composition of transudations of frequent drawings off of the fluid. He compared the transudations derived from various parts of the body, and endeavored to refer the differences in chemical composition found to differences in the capillary network and blood pressure. He demonstrated the presence of soaps in the blood and lymph, at that time commonly denied, and studied the presence of indican in the urine, a body the true significance of which as a measure of the putrefaction in the alimentary canal was shown by his pupil Baumann. One of the last most important of his discoveries was that of "chitosan," a decomposition product of chitin, the dis-

covery of which threw light on the chemistry of this important animal substance. Hoppe-Seyler's main work, however, to which we may direct attention, was done upon the red pigment or hæmoglobin of the blood, upon processes of oxidation in the organism, upon the chemistry of fermentation, and upon chlorophyll.

It is not too much to say that if all work but Hoppe-Seyler's upon hæmoglobin should be obliterated, we would still have nearly all that is known of that important substance. It was Hoppe-Seyler who gave the name hæmoglobin, it was he who discovered that it was this substance in the red blood-corpuscles that gave them their power of carrying oxygen, and that hæmoglobin was a definite chemical compound. He discovered the difference between hæmoglobin and oxyhæmoglobin. The absorption bands in the spectra and the difference in the spectra of hæmoglobin and oxyhæmoglobin were also discovered by him, and he did more than any other one man to apply the spectroscope to the study of the blood pigment. It was Hoppe-Seyler who found that the oxygen combined with and was given up from the hæmoglobin in a molecular and not an atomic form; he showed that carbonic oxide enters into a stable combination with hæmoglobin, and thus explained the peculiarly poisonous nature of this gas. He discovered and named the decomposition products of hæmoglobin, methæmoglobin, and hæmochromogen. He showed that hæmin was simply the hydrochlorate of hæmatin, and pointed out how the hæmoglobin molecule could be taken to pieces and built up by reduction. On the chemistry of hæmoglobin he published no less than thirty papers.

An interesting discovery made by him was the cause of the sudden death to which men were subject who, after working under compressed air, suddenly returned to the ordinary atmosphere. He showed that under such circumstances the dissolved gases of the blood quickly escaped from solution with fatal results. This discovery indicated the proper manner of avoiding such disaster by a gradual return to the normal atmosphere, and has been the means of saving many lives.

One of the greatest discoveries of Hoppe-Seyler was that the tissues and not the blood are the seat of the oxidations of the body. This was still more convincingly shown later by Pflüger. By this discovery Hoppe-Seyler's attention was attracted to the respiration of protoplasm, with what results we shall shortly see.

His work on hæmoglobin led Hoppe-Seyler in two directions: one was toward the composition of cells, the other toward respiration. Both paths have been followed with good results. In examining the composition of the red blood-corpuscles of mammals, Hoppe-Seyler discovered that the percentage of phosphoric acid contained in the

residue of the alcoholic extract was too high for the body to be protagon, as had previously been supposed. He put his pupils Manassien and Diakonow on this problem. The former quickly found the substance to be not protagon, but lecithin, a peculiar nitrogenous phosphorized fat, and the latter laid bare the chemical nature of this substance. Hoppe-Seyler himself proceeded to examine other cells for the presence of lecithin and cholesterin, and soon recognized that these substances, as well as the albumins, potassium phosphate, and glycogen, must be considered ever-present constituents of protoplasm. Hoppe-Seyler further showed that the lecithin generally existed in the cell, not free, but in combination with albumin. This fact drew Hoppe-Seyler's attention to similar compounds which are formed by albumin combined with other substances, and he proposed for such bodies the name "proteids," a name which they have subsequently borne.

The discovery of lecithin drew attention to the organic compounds of phosphorus in protoplasm. There were many indications that the nuclei contained such a substance, although the difficulties in its isolation had hitherto been insurmountable. His pupil Miescher was placed on this problem, and discovered the "nucleins," probably the most important constituents of protoplasm thus far recognized. Hoppe-Seyler himself discovered "vitellin," the first of the pseudo-nucleins, and casein was soon shown to have a similar phosphorized radicle.

In the chemistry of respiration Hoppe-Seyler was personally active, and formulated a hypothesis of the chemical nature of respiration and living matter which is practically the only well-grounded theory of its kind extant, and one which has seldom been surpassed for brilliancy. By a stroke of genius he correlated the newly discovered reducing powers of protoplasm with its oxidizing powers, and recognized the essential identity of the processes of life and putrefaction. This idea threw light on many phases of cellular metabolism. It was first briefly mentioned in the *Medicinisch-chemische Untersuchungen* in 1871. It was clearly stated in volume xii of Pflüger's *Archiv für die gesammte Physiologie* some years later, and forms the kernel of most of his subsequent work.

The oxygen of the air, as is well known, is in a molecular or inert state, and not in an atomic form. It is unable, in this form, to carry out the oxidations of protoplasm. To do this it must be first made "active," either by conversion into ozone or by having its molecule split. Hoppe-Seyler's theory of respiration turns on the fact that in protoplasm and in putrefying masses, reducing substances are formed which are able to split the oxygen molecule, setting free atomic oxygen. In this manner, if only air

have access, putrefying fluids, like protoplasm, are able to oxidize completely the most resistant substances, side by side with strong reductions. Hoppe-Seyler noticed that if animal substances be allowed to putrefy in vessels deprived of air, intense reductions ensue, hydrogen gas is often set free, and the whole chemical transformation is entirely different from that which the same substances undergo if a current of air be constantly forced through the fluid. In the latter case the transformations are oxidations, and finally are of a most complete kind, little else than nitrates, carbonates, and sulphates being left. If a putrefying fluid be allowed to stand exposed to air, Hoppe-Seyler discovered that at the surface the most intense oxidation ensued, while in the depths there were equally intense reductions. He found, further, in studying the fermentation of fibrin and calcium lactate, as well as other substances, that if no oxygen were present large quantities of hydrogen gas were evolved, if air were present no hydrogen was evolved. He immediately recognized in nascent hydrogen a reducing agent capable of causing the strong reductions and of splitting the oxygen molecule, thus indirectly causing oxidation. He suspected that nascent hydrogen would combine with one atom of the oxygen molecule to form water, setting the other atom free, and experiment fully confirmed this hypothesis. If palladium be heated in a stream of hydrogen, it combines with the latter. If it now be brought into water, the hydrogen is liberated in the atomic state. Hoppe-Seyler found that palladium loaded with hydrogen would carry out oxidations and reductions similar to those of putrefying fluids. If such a palladium mass be half immersed in water containing benzol, hæmoglobin, potassium iodide, or indigo, in the depths of the fluid strong reductions ensue, with at the surface equally violent oxidations. In such circumstances oxyhæmoglobin at the surface is transformed into methæglobin, benzol to phenol, indigo to indigo white at the bottom and indigo yellow at the surface, and iodine is liberated from its potassium combination. Hoppe-Seyler believed that in protoplasm a substance was present which acted somewhat like potassium hydrate or the ferments in the putrefying masses, causing a saponification, and at the same time a transference of an oxygen atom from a hydrogen to a carbon atom, with the liberation of nascent hydrogen, or other reducing substance. The nascent hydrogen, in the manner already indicated, caused both intense reductions as well as oxidations. In this manner, as is well known in chemical processes outside of the cell, many syntheses and polymerizations can be brought about, and it would seem necessarily to result, in protoplasm, in just such a constant rearrangement of molecules as is imagined constantly to be transpiring there. Hoppe-Seyler believed that the oxygen

would cause the formation in living matter of a great number of syntheses by the building of anhydrides with the formation of water. The chief difference between living and lifeless protoplasm was about the difference between an anhydride and an acid. When death ensued, oxidation no longer took place, but the saponification continued until complete.

Although this hypothesis is necessarily difficult of proof, many facts indicate its possible truth. That protoplasm is the seat of reduction and oxidation no one will probably deny, and that by a process of alternate reduction and oxidation many of the transformations of substances by the organism may be repeated outside the cell is also undoubted. Thus Drechsel, by a rapidly alternating electric current, has succeeded in producing urea from albumin. It is also well recognized that many of the best-known syntheses effected by the organism are formed by a dehydration. This is true of the formation of fat, of the ethereal sulphates, of hippuric acid, of the camphor-glycuronic acid, and of the chondroit-sulphuric acid of cartilage. In this manner, too, as Hoppe-Seyler discovered, fatty acids of many carbon atoms may be synthesized from comparatively simple compounds. It seems not improbable that Hoppe-Seyler thus obtained a glimpse of that promised land toward which the physiological chemist has been patiently working for the past forty years, where the mysteries of protoplasm shall be made clear. Whatever may be the exact details of the process of respiration, certainly Hoppe-Seyler's discovery that reducing substances in the presence of air may induce powerful oxidations is one of the most brilliant and suggestive made in biochemistry.

Impressed by the similarity of living and fermentative processes, Hoppe-Seyler devoted much time to the chemistry of the latter. He made the first classification of fermentations, distinguishing those in which a simple hydration or saponification takes place, as in the digestive fermentations, from those characterized by the transference of an oxygen atom from a hydrogen to a carbon atom, with the liberation of hydrogen. To a certain extent he made clear the chemical processes of fermentation, and his researches serve as a solid and suggestive basis for further work. Hoppe-Seyler was throughout a strenuous upholder of the Liebig view of the essential identity of fermentations, whether induced by chemical bodies or living germs. His position has been justified by the recent brilliant discovery that the alcoholic fermentation of sugar by yeast, long believed to be dependent on the life of the yeast cell, is due to a substance which may be isolated from the living yeast. Hoppe-Seyler contributed also to our knowledge of the fermentation of

cellulose into carbonic anhydride and marsh gas, which, as he showed, was due to a bacterium resembling or identical with the *Bacillus amylobacter*.

As might be expected, Hoppe-Seyler devoted considerable time to chlorophyll. He discovered and named the "chlorophyllan," a crystalline derivative of chlorophyll. He devised an ingenious method for showing that chlorophyll, in the sunlight, liberated oxygen in a molecular and not an atomic state. If a green plant be brought into a glass tube in water, a little putrefying blood added, and the tube hermetically sealed and placed in the dark, all oxygen is consumed and the tube shows the spectrum of hæmoglobin. If the plant be brought into the direct sunlight, the hæmoglobin is transformed by the oxygen liberated by the chlorophyll bodies into oxyhæmoglobin, which gives a characteristic spectrum. If the oxygen were liberated in an atomic state, the spectrum of methæmoglobin would appear.

Let us now glance briefly at Hoppe-Seyler's influence upon physiological chemistry. He may be called the father of this science, for, although the beginnings of biochemistry were identical with those of organic chemistry, both taking their origin in Lavoisier's experiments on oxidation, Regnault and Renard's on respiration, Chevreul's on the fats, and Liebig's and Wöhler's on urea, muscle, and animal metabolism, yet in the early half of the century the interest of the purely chemical analysis and synthesis of organic bodies had almost completely absorbed the attention of chemists. It was Hoppe-Seyler's great merit to perceive and to emphasize, with all his might, the great importance of physiological chemistry in the arts, in industries, and in medicine. His clear glance perceived that a knowledge of the chemical constitution and chemical processes of organisms in health and disease must underlie any proper treatment or understanding of disease, a fact which in the world at large to-day is becoming better and better recognized.

To further the development of this science, whose importance he perceived, he saw that it must have an undivided attention; that it must be divorced from physiology and pathology on the one hand, and from chemistry on the other, and given an independent position in the university faculty. In this contention Hoppe-Seyler met with fierce opposition in Germany, particularly from Pflüger and other physiologists and chemists, so that to-day there is but one professorship of physiological chemistry in Germany—namely, that at Strasburg. In other countries Hoppe-Seyler's idea received more favorable attention, and he lived to see such professorships established in Sweden, Norway, Switzerland, Austria, Russia, and America.

Hoppe-Seyler should be gratefully remembered by posterity for his service in thus putting on its feet and starting in motion a science the future of which man can but guess at, but which is perhaps fuller of promise for the alleviation of suffering, for the betterment of the conditions of existence of mankind, than any other science or group of sciences, for it holds somewhere within it the keys of the riddles of life, disease, decay, and death.

In no one way did Hoppe-Seyler set the science further forward than in the founding of a journal, the *Zeitschrift für physiologische Chemie*, devoted exclusively to biochemistry. The journal received at the outset both hearty support and hearty opposition, but it still remains as the official organ of publication of biochemical works. Previous to the establishment of this paper, works treating of the chemistry of organisms were scattered in agricultural, chemical, physiological, pathological, and medical journals, just as they are in the English language to-day. They thus lost largely in effectiveness. Hoppe-Seyler brought all biochemical efforts to a focus, with admirable result.

Hoppe-Seyler as a teacher could be known only by his immediate pupils. Baumann and Kossel have written of him that "with untiring patience he introduced the beginner to practical chemistry; no ignorance, no lack of skill exhausted his forbearance." He may be judged, however, by us through the men who were his pupils. No test of a man's mind is more certain than the influence he exerts upon those who associate with him, particularly his pupils. Judged by this test Hoppe-Seyler must rank very high indeed. Whether it is that a man of his type naturally attracts to him the most promising of the rising generation, or whether even an ordinary man absorbs from such a teacher an amount of light which, like a fluorescing substance, he is enabled thereafter to emit, certain it is that Hoppe-Seyler's pupils include an extraordinary number of men of ability. His pupils and his pupils' pupils are the principal workers in physiological chemistry to-day, and a mere enumeration of their achievements would be a history of the development of the science in the last forty years.

As a teacher Hoppe-Seyler strongly resembled Ludwig, his great contemporary physiologist, Brooks, of Johns Hopkins, Agassiz, and Liebig, the chemist. He offers a striking contrast in this respect to Claude Bernard, whose great genius affected the science of physiology principally by its own extraordinarily keen and suggestive researches, and when it died left no heirs.

Such was Hoppe-Seyler—a winning personality, a courageous upholder of what he believed true, a keen investigator, a far-sighted, broad-minded, kind-hearted man.

Editor's Table.

TOLSTOI ON ART.

THE great Russian writer, to whose views on the subject of science we made a passing reference last month, has published a book under the title of What is Art? which has been translated into French by M. de Wyzewa, a well-known contributor to the *Revue des Deux Mondes* and other periodicals. The author's treatment of the question is very radical; and, as he has assailed the theories of all previous writers on the subject, the theory which he himself puts forward will probably receive abundant criticism. To our mind, waiving all minor questions, his book seems to be one of great importance and value. It is a direct appeal to the conscience and intelligence of the cultivated classes, summoning them to consider whether far the larger part of that which they applaud as art is art at all in the true sense, and whether its effect on themselves and on the world at large is not injurious rather than beneficial. The appeal is made with so much vigor and sincerity, and is supported by so many apt and powerful illustrations, that we shall be surprised if it does not produce far-reaching effects of a most salutary kind. Such a voice as has now been raised has long been wanted to cry out to a luxurious generation that they are abusing the advantages they possess, that their ideals of life are false, and that art in their hands has sunk from its high position as a chief means of the moral and intellectual elevation of mankind and become little else than the echo of their affectations and the servant of their vanity and pride.

Count Tolstoi examines the various definitions that have been given of art and finds them all unsatisfactory, though he pronounces the views put forward by Darwin and Spencer as infinitely superior to those of the metaphysical school which founds art upon the perception of beauty. He hazards a theory of his own, which is that art is the means adopted by men to communicate their emotions and sentiments, as distinct from simple statements of fact, to their fellows. Where any communication is made from man to man in such a way as to awaken in him who receives it the same emotion as is experienced by him who makes it, there, according to Tolstoi, art has intervened. Art may be employed in the service of an evil sentiment; but that does not prevent its being art, provided the sentiment is truly personal to one individual and effectively conveyed to another. In the same way ordinary language might be employed in perfectly logical form to convey a false statement or a wrong opinion; but just as the proper and normal use of language is to convey true statements and correct opinions, so the proper and normal use of art is to convey right sentiments, and, above all, sentiments which make for the binding together of mankind in fraternal union. Art finds, according to this writer, its highest use when it is employed in the service of religion; and the religion of to-day, he holds, consists mainly in the affirmation that all men should be brethren. The best examples of art are those which give expression to sentiments in which all mankind can share; and judged by this standard the art most highly prized by the cultivated classes of to-

day is not art at all, since it is designed merely for the amusement of a few, and is altogether beyond the comprehension of the many. Moreover, if the many could comprehend it, it would do them as little good as it does to the exclusive circles for whose special gratification it is produced.

Whatever may be said of this definition of art, there is little doubt in our mind that it furnishes a basis for a fruitful consideration of the whole subject. We incline, indeed, strongly to the opinion that for the average man the most profitable point of view is that which the author has indicated. Let it be granted that the purpose of art is to convey emotion from one mind to another and we have at once a criterion that can be usefully applied both to alleged works of art and to alleged artists. We can ask the latter: What emotion personal to yourself have you that you wish to convey? If you have none, then, whatever your technical ability, you are not an artist. If the emotion is one the propagation of which will do harm, then you are using your art to do injury to your fellow-men, simply to earn from the unthinking or the vicious the praise of having done a bad thing well. If the emotion is one which all men will be the better for sharing, then in proportion to the strength with which you experience it and the power you possess of communicating it to others, you are an artist and a benefactor of mankind. Or we can deal directly with works tendered for our admiration as artistic. What emotion do they convey? To what sentiments do they appeal? Does the message which they bring come direct from the heart of the author, or is it the repetition of another man's message—an echo of tones and a mimicry of methods elsewhere found successful? If these works give pleasure, what is the nature of the pleasure they give? Is it such as accompanies an enlargement of our sympathies and the raising of our hopes for the future of mankind? Or is it the pleasure of gratified vanity or cynicism? Is it a pleasure which makes our hands "swifter unto good," or one that makes us more self-centered, more self-sufficient, more self-enthralled?

It is much to be desired that men in general would criticise works of art from this point of view. They might occasionally err in doing so; but their errors would be rare in direct proportion to their own sincerity, and the effect in strengthening their powers of judgment would be very marked.

Our author furnishes in the following passage a familiar example of what we are frequently called upon to admire as "art":

"A musician of renown seats himself before you at the piano, and plays for you what he says is a new composition of his own or of some present-day musician. You hear him produce strange and noisy sounds, you admire the gymnastic exercises accomplished by his fingers, and you also see clearly that his intention is to make you believe that the sounds which he produces express different poetical moods of the soul. His intention, I say, is clear; but the only feeling he communicates to you is one of mortal weariness. The performance lasts a long time, or at least seems to you to last a long time, owing to your utter failure to receive any distinct impression; and the idea comes to you that perhaps the whole business is a mystification—that the artist is trying an experiment on you, and is just flinging his hands at random over the keys in the hope that you will be taken in, and that he will have a good laugh afterward at your

expense. But no. When at length the piece is finished, and the performer, all trembling and bathed in perspiration, rises from the piano manifestly expecting your applause, you see that it is all very serious. The same thing happens in concerts where they play pieces by Liszt, Berlioz, Brahms, Richard Strauss, and numberless composers of the new school."

It strikes us that there is much truth also in the following: "To say that a work of art is good, and that nevertheless it is incomprehensible to the majority, is as if we were to say of a certain food that it is good, but that most men should be careful not to eat it. The majority of men may not like decayed cheese or 'high' game, dainties much esteemed by persons whose taste is perverted; but bread and fruits are only good when they please the majority of men; and it is the same in art. A perverted art may not please the majority of men, but good art must perforce please everybody."

We must add a passage which contains a most powerful arraignment of the absurdities and wrongs which are every day being perpetrated in the name of art. Regarding art as an organ of human progress, the author points out the disastrous consequences which flow from its perverted action:

"The first of these consequences is too conspicuous to escape notice. It is the vast expenditure of human labor upon things that are not only useless but, as a rule, pernicious. To think that children, handsome, full of life, with every natural endowment necessary for happiness, are condemned from the moment they leave the cradle, some to practice scales six, eight, ten hours a day, others to dance on tiptoe, others to do singing exercises, others to draw from the antique, from the nude, and others again to compose phrases destitute of meaning according to a particular system of rhetoric! From year to year these unhappy victims go on wasting in these murderous occupations all their physical and intellectual forces, all their aptitude for the comprehension of life. We often say, What a lamentable spectacle to see little acrobats twisting their legs round their neck! But is it not a still more sinister exhibition to see children of ten giving concerts, and little collegians of the same age who know by heart all the exceptions in the Latin grammar? In such pursuits they not only waste their physical and mental forces, but they undergo a process of moral depravation which renders them incapable of any kind of service useful to human beings. Accepting in society the position of purveyors of amusement to the rich, they lose the sentiment of human dignity. A hunger for praise develops in them to so monstrous an extent that they suffer through life from this diseased condition, and expend their whole moral being in the effort to appease an insatiable craving. Yet there is something more tragic still, namely, that men who sacrifice their whole life to art, and who are lost for all other purposes, not only do nothing to advance their art, but even cause it immense damage; the reason being that in their academies and colleges and conservatories all they learn is to counterfeit art, so that they become henceforth incapable of conceiving true art or of doing aught except helping to crowd the world with the counterfeit works of an art divorced from Nature."

Before finishing his book Count Tolstoi finds time to say a needful word or two about those men of science who forget the social function of science as completely as some artists or would-be artists forget the

social function of art. He well compares science and art in their relations to one another with the lungs and the heart in the human organism. Neither organ can work perfectly unless the other works perfectly also. A defective science makes a defective art, and *vice versa*. This is an interesting point and one that deserves careful attention. We have said enough to show that the great Russian has produced a work which the civilized world of to-day can not afford to ignore, and which, when it has drawn the fire of all who are offended by the positions it takes, will be recognized as a strong and irrecusable plea for the rights of humanity in the judgment of works of art and of all other works whatsoever.

A GREAT COUNTRY.

WHAT is "a great country"? The schoolboy idea is that it is one that can thrash other countries; and, according to this notion, the greatest country of all is one that can "whip all creation." This idea might not do much harm if it were confined to schoolboys, but when it is shared by grown men the case is more serious. "When I was a child, I spake as a child, I understood as a child, I thought as a child; but when I became a man, I put away childish things." Here is a childish thing, however, which thousands who have reached man's estate find it very difficult to put away, and have not in point of fact put away. They still think that a country's greatness consists in its military strength—in other words, in the power it could bring to bear for the destruction of rival nations; and, if that country is their own, they exult to think of the havoc it could create among its enemies in the event of a conflict. That a country should be strong for defense is not enough, in the opinion of such persons; it must be strong for offense also; it must be strong enough to swagger.

How very different this is from the spirit of true patriotism hardly needs pointing out. Take that passage in Shakespeare in which the spirit of patriotism receives perhaps the strongest expression ever given to it in literature, and how little do we find of mere exultation in military strength! We refer to the words in which the dying John of Gaunt laments over the evils which the new king, Richard II, is bringing on the state:

> "This royal throne of kings, this sceptered isle,
> This earth of majesty, this seat of Mars,
> This other Eden, demi-paradise,
> This fortress built by Nature for herself
> Against infection and the hand of war,
> This happy breed of men, this little world,
> This precious stone set in the silver sea,
> Which serves it in the office of a wall
> Or as a moat defensive to a house
> Against the envy of less happier lands,
> This blessed plot, this earth, this realm, this England,
> This nurse, this teeming womb of royal kings,
> Feared by their breed and famous by their birth,
> Renowned for their deeds as far from home,
> For Christian service and true chivalry,
> This land of such dear souls, this dear, dear land!"

There is some reference here to military power—not unnatural when we consider that the date of the play is within eight or ten years of the Spanish Armada—but how little in comparison with the heartfelt expression of love for a land that was the home of a happy and prosperous people—"this land of such dear souls, this dear, dear land"! Moreover, in so far as the poet exulted in the strength of his country, it was the quality of its inhabitants he thought of and dwelt upon—not the engines of war that it possessed or the vastness of its pecuniary resources. A great

country in the true sense is one that evokes this feeling in its sons and daughters, and evokes it not less in times of peace than in times of war.

It may here be remarked that the ambiguity of the word "great," as applied both to men and to nations, is the source of no slight perversion of moral judgment. When a man is spoken of as a "great" man without qualification, the inference is only too readily drawn that he is one who may serve as a model for imitation; and yet many so-called great men have had the most serious vices of character, and many have been guilty of the most appalling crimes. "Even so," their eulogists contend, "it can not be denied that they were great." So be it, only let it be understood that the word great so employed has no necessary connotation of moral excellence, of superior humanity, or of any of the qualities which might entitle a man to the love and gratitude of his fellows. The trouble is that, make what reserves we may, the word, as often as it is used, creates illusion, or else has the equally disastrous effect of making us think that where "greatness" is concerned moral considerations are of quite inferior importance.

So, when we speak of a great country, we are only too apt to think of its wealth and strength, and only too readily ignore the elements which go to make up a really great national character and a prosperous and stable commonwealth. We do not care to ask how it got its gold, or what it is doing with it, or at what moral cost it is maintaining its military organization. We do not ask whether liberty is flourishing within its borders, or whether its people are strong in the sum of their qualities, in energy, in resourcefulness, in a sense of public duty. We are ready to consider these things at other times; but the spectacle of military strength imposes on our imaginations; and, in schoolboy fashion, we account that nation especially great that has all its preparations made for striking a deadly blow at an enemy in the shortest possible time. It is lamentable that, in a country like this, such views should prevail to the extent to which they do, and that a large proportion of our people should have become enamored of the military ideal. The evil resulting from such a state of opinion is twofold: a wrong direction is likely to be given to our foreign policy, and the internal development of the country is in danger of receiving a serious check.

For, let it never be forgotten that the great problem which every community is set to solve is the problem of social evolution under the guidance of the principle of justice. Even the most military communities are working at this problem in their own way, but under disadvantages directly proportioned to the extent of their military organization and the amount of national energy which it absorbs. No reasonable person will deny that the highest well-being of any state depends upon the equity with which its laws are administered, the protection accorded to individual rights, and the scope allowed to individual initiative and energy. No one will deny either that the intellectual and moral condition of a people is, with reference to the ultimate ends of human existence, of vastly more account than their preparedness for offensive warfare. If these propositions are admitted, how can it be regarded otherwise than as a calamity that the ambition of our people, whose position is so eminently favorable to peaceful development, should be diverted into military channels and turned toward military ideals? Some day we shall have to turn back and seek for things that make for peace, the things that tend

to the true upbuilding of the nation and the development of a civilization founded on justice and humanity; but unless that day comes soon evil may be wrought both to our national character and to our institutions which it may take long years to repair.

Scientific Literature.

SPECIAL BOOKS.

MR. H. C. PORTER'S translation of *Strasburger's Text-Book of Botany** was undertaken with the consent of both authors and publishers from the second revised German edition. The translator has aimed to adhere closely to the German original, making neither alterations nor omissions; to avoid any unnecessary introduction of new terms, adopting as far as consistent with the German the existing terminology, and conforming as far as possible to the usage of previous translations in rendering technical words of a purely German signification. For such departures as he may make from these rules he offers satisfactory explanations. The names of the authors, all of the University of Bonn, and their high reputation in their several fields of botanical study, attest the quality of the book, and this testimony is fortified by the fact that it was necessary to issue a second edition within a year after its first appearance. In the introduction the subjects of the imperceptible difference in the fundamentals between animal and vegetable life, of evolution, of the distinction between living organs and lifeless bodies manifested by the quality of irritability in the former, and of spontaneous generation disproved by the researches of Schwann and Pasteur, are touched upon. Botany is divided into a general and a special part. In the general part the structure (morphology) and function (physiology) of plants are considered; in the special part the particular structure and functions of the special orders of plants are discussed. In the former part morphology and physiology are treated separately, in the latter part conjointly. The morphology is treated as external, involving the development of form in the plant kingdom, relations of symmetry, branch systems, the shoot, the root, and the ontogeny of plants; and internal, embracing the histology and anatomy. In the special part the theory of evolution is credited with having first afforded a true basis for a natural system of classification, expressive of relationship and family. The system of Alexander Braun, as modified and further perfected by Eichler and others, is followed. This book would ordinarily be characterized as a technical as distinguished from a popular scientific work, for it embodies the fruits of deep research by masters of the science. But it appears to be, for a technical work, remarkably easy reading. This is because of the simple forms of expression preferred by the authors and the translator, and of the pains taken to explain the hard words which are by no means wanting. The publishers promise shortly an edition of the work in two volumes, which will be sold separately, the first volume to contain Strasburger's

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* A Text-Book of Botany. By Dr. E. Strasburger, Dr. Fritz Noll, Dr. H. Schenk, and Dr. A. F. W. Schimper. Translated from the German by H. C. Porter. With 594 Illustrations, in part colored. New York: The Macmillan Company. Pp. 632. Price, $4.50.

Morphology and Noll's Physiology, or the general part, and the second the special part, or Schenk's Cryptogams and Schimper's Phanerogams.

MR. *William E. D. Scott* seeks in his *Bird Studies** to place before students and others who wish to acquire knowledge on birds a means to that end—in other words, to invite them to a more intimate acquaintance with them. To this work he brings, in the shape of original notes based on field work, the fruits of his own studies during the past thirty years; and has further consulted, to insure accuracy, the standard works on North American birds; and he believes that all the kinds of birds of the land known to occur in the cases dealt with down to November 1, 1897, are included in his treatise. We say birds of the land, because the water birds are not included, being reserved for another volume. The area covered—called eastern North America—is that part of the continent east of the Mississippi River, Lake Winnipeg, and the western borders of Hudson Bay, with Greenland and the islands which naturally associate themselves with the mainland of the region. In the descriptions the birds are not grouped by the usual systematic classifications, but as one would be most likely to meet them and according to the places they frequent. "It is believed that a knowledge of the birds nearest to us is the best point of departure, and is less liable to lead to mental confusion than if all the members of a given systematic group—as, for instance, all the thrushes or all the sparrows of the entire region—were to be introduced or placed before the student in a body." Certain kinds have come to associate themselves more, on the whole, with the regions round the house than with any other locality. Others are in the same way characteristic of the woodland, the field and meadow, bush, and swamp. After these the birds along the highway, "in the woods," "across the fields," "in marsh and swamp," and "by stream and pond" are described; and, finally, a systematic table of the land birds of eastern North America is given. The letterpress descriptions are models of what such articles should be when directed to untechnical readers—brief, comprehensive, direct, and definite. The one hundred and sixty-eight illustrations are of various degrees of satisfactoriness. The pictures of live birds and nests and of bush surroundings are lifelike and true, but show the difficulty of managing outdoor light when the bird, and not the artist, selects the moment for taking the picture. The pictures of dead birds are mostly excellent photographs, but liable to objection in other respects; they do not show the bird as it is in life, and are useless for purposes of identification; they are not agreeable to look at, and, at a time when the most strenuous efforts are hardly sufficient to prevent destruction of the birds and secure their preservation, they are a bad example. The book would have been better if they had been left out of it.

OUR impression as we take up Mr. *Goldwin Smith's Guesses at the Riddle of Existence*† is a strong one of the pity it is that we can not enjoy the reading of the books of the Bible free from the traditions with which they have been surrounded, and the glosses and scholasticism and false interpretations that have been put upon them. Here is a man, candid and one

* Bird Studies. An Account of the Land Birds of Eastern North America. With Illustrations from Original Photographs. New York and London: G. P. Putnam's Sons. Pp. 363. Price, $5.

† Guesses at the Riddle of Existence, and other Essays on Kindred Subjects. By Goldwin Smith. New York: The Macmillan Company. Pp. 244. Price, $1.25.

of the strongest-minded thinkers of the time, religiously and devoutly inclined, expressing his anxiety about subjects that need not have troubled him at all if he had been permitted to read his Bible without thinking of things that really belong outside of it, but are taught us all in childhood as gospel truth. The spirit in which his pages are penned, he says, "is not that of agnosticism, if agnosticism imports despair of spiritual truth, but that of free and hopeful inquiry, the way for which it is necessary to clear by removing the wreck of that upon which we can found our faith no more. To resign untenable arguments for a belief is not to resign the belief, while a belief bound up with untenable arguments will share their fate." Three of the five essays in the book have appeared in periodicals; the others are new in print in their present shape. In the first, which gives its name to the book, the works of Drummond, Kidd, and Balfour relating to man, his origin and destiny, are reviewed. In the second, The Church and the Old Testament, the authenticity of the Old Testament is questioned. The other essays relate to the doctrine of another life, the miraculous element in Christianity, and morality and theism. While theologians have done harm with their hard-and-fast interpretations "essential to salvation," evidence that is added to and never contradicted with every new season's explorations in the Orient shows that the critics whom Mr. Smith seems inclined to follow have egregiously erred in the ground and method of their attacks on the authenticity of the books of the Old Testament. These explorations show that those books reflect the very life and spirit of the times to which they relate, and must have been contemporary with them or compiled from contemporary documents, giving in the cosmogonies, etc., the earliest traditions of mankind, and in the historical statements references to facts concerning which other evidence has been or is likely to be at any time found.

GENERAL NOTICES.

THE life and work of Pasteur have been affectionately and appreciatively described from the familiar and the French point of view in M. Vallery Radot's *Histoire d'un Savant par un Ignorant* and in M. Duclaux's *Histoire d'un Esprit*, and from a more purely scientific point by Mr. Roux in his article on *L'Œuvre Médical de Pasteur*. Now, *Dr. and Mrs. Percy Frankland*,* acknowledging indebtedness to all these authors, present the subject from the point of view of English students of science. Their purpose is to extend and make more universal the general world's acquaintance with the great master and the methods through which his wonderful discoveries were made. His achievements, they say, "are so interwoven with the circumstances by which our daily life is surrounded, that it is all but impossible to find any one who is not directly or indirectly concerned with some part or other of his great life work." The authors make a straightforward, clear, and attractive presentation of the early life and studies and successive researches by means of which Pasteur achieved the highest point of scientific fame and won the right to be regarded as one of the world's greatest benefactors. A full account is given of the organization and methods of the *Institut Pasteur* and of the work of Pasteur's associates there and of his students.

The chief aim of Mr. *Clark's Laboratory Manual of Practical Botany*, we are informed by the publishers,* is not to find the names of flowers, but to gain some real knowledge

* Pasteur. By Percy Frankland and Mrs. Percy Frankland. New York: The Macmillan Company (Century Science Series). Pp. 224. Price, $1.25.

* A Laboratory Manual of Practical Botany. By Charles H. Clark. American Book Company. Pp. 271. Price, 96 cents.

of the life histories of plants. It seeks a new presentation of the subject, making use of the best modern method of study, and giving prominence to laboratory processes. The course of study outlined in it is intended to give the student a general view of the subject, and at the same time to lay a foundation on which more advanced studies may be built. As the length of time given to the study of botany differs widely in different schools, the author has endeavored to furnish a course that may be made very elastic; and room is therefore provided in it for selections, in aid of which a few hints are given. A considerable amount of previous study is supposed to have been given to the gross morphology of the parts of flowering plants, with some attention to the division into groups and classes, and knowledge enough of analysis to find the names of plants. "With this preparation it seems . . . that the pupil can enter with profit upon a course which will give him a general view of the whole plant world, beginning with plants of the simplest organization." Such is the present course. The explanations to the experiments are clear and direct.

Mr. Mallock, in his Aristocracy and Evolution, has submitted the preachings of the socialistic and labor agitators with arguments drawn from philosophy. Mr. *Freeman Otis Willey* attacks them and disposes of most of them in *The Laborer and the Capitalist** by subjecting them to the test of plain common sense. He takes them up as they are declared on the street, in the press, from the pulpit, in the legislative halls, and on the stump, and, one after another, exposes the practical fallacies that are in them. Thus he does with the questions of monopoly, the accumulation and concentration of wealth, the relations of capital and labor, railroads, rented homes, wages, taxes, etc.; as to all of which points the practical method of looking at the subject and treating it gives his observations great force.

In the series of Physical and Electrical Engineering Manuals of J. Henderson and S. Joyce, it is the object of the authors to provide a course of instruction for carrying out a progressive series of experiments in the subjects, arranged so that the usual apparatus at the disposal of a laboratory, though not especially designed for any particular experiment, may, nevertheless, be used with advantage in a variety of ways. They have also sought to arrange experiments of such character that a student working *alone* may be able to obtain satisfactory results. The second volume of the series* is devoted entirely to practical work in electricity and magnetism, the department of physical work being reserved for a volume by itself. The introductory chapter contains a most excellent series of instructions as to the methods of observation and the manner of making them. The student "must never be in a hurry. A week spent in discovering and overcoming some source of error will be well-spent time, and may be of more educational value than the performance of the original experiment itself. Above all things, however, the experimenter must be methodical," and more of similar tenor. Exact directions are given, likewise, concerning the management of the instruments. The measurement of resistance is dealt with first in the order of experiments, with a brief account of the methods of measuring in absolute units. In choosing methods for the various measurements it has been the aim to take only those best suited for the purpose. Lists are given, at the end of each chapter, of references to the more important original papers bearing on the subject of the chapter to be fonnd in the scientific periodicals.

Mr. *R. Floyd Clarke* assumes that the law seems to laymen and to some who attempt the study of it a crabbed, difficult, and dry pursuit, and attempts in his *Science of Law and Law-making*† to make clear to average readers some of its truths and introduce them to a correct conception of the system under which they live. While admitting it as true that the detail and doctrines

* The Laborer and the Capitalist. By Freeman Otis Willey. New York: Equitable Publishing Company. Price, $1.25.

* Practical Electricity and Magnetism. By John Henderson. Vol. II. New York: Longmans, Green & Co. Pp 488.

† The Science of Law and Law-making. Being an Introduction to Law, a General View of its Forms and Substance, and a Discussion of the Question of Codification. By R. Floyd Clarke, of the New York Bar. New York: The Macmillan Company. Pp. 473. Price, $4.

and the applications thereof of any system of law have, to the general student, the forbidding qualities ascribed to them, he maintains that that which is valuable as wheat or gold is to be got out of it. "While the decision of special law cases, petty or otherwise, that arise in daily life may embrace complicated deductions to be made from technical rules, and end in inductions of interest only to the professional man, and which to the unlearned mind appear to have no reason for their existence, yet other special cases may require in their decision the assertion and application of most important general principles—principles of interest to every one, and whose assertion either way reacts upon the future well-being of all." He tries, therefore, to write an introduction to law which shall enlighten the intelligent lay reader as to the beauty and interest of its problems; to reduce the discussion of the code question to a practical, concrete form; to elaborate the idea of the fundamental and intrinsic difference between the two forms of statute and "case" law; and to draw the proper conclusions and apply those principles to actual legislation, judicial or legislative, and to determine by a practical test the province of each and the best way to conserve them.

The late Professor Jowett is credited with having pronounced Italian literature the greatest in the world after Greek, Latin, and English. It is more intimately affiliated to antiquity, Mr. *Garnett* says in the preface to his *History* of it,* than any other European literature, and may indeed be regarded as a continuation or revival of the Latin. Yet it was long in appearing. This fact is perhaps partly due to the earlier Italian writers of mark having continued to express themselves in Latin, and the vernacular writings having had to fight their way slowly up. This fact, further, worked greatly to the disadvantage of the appreciation of Italian literature, for much that should have belonged to it and which might have helped us estimate the capacity of the Italian mind was in another language. Dante and Petrarch and others, masters and classics in Italian, wrote also much in Latin, and their native language is robbed thereby of much that would otherwise have been its best work. It is another disadvantage to the reputation of the Italian mind that many of its greatest geniuses did not express themselves at all, or at most comparatively little, in writing, but in other fields, especially art and music. So it was with Michelangelo—greatest of all—Leonardo da Vinci, and half a dozen others whom Mr. Garnett names, including Galileo, Columbus, and Napoleon; while Michelangelo, Leonardo da Vinci, and Benvenuto Cellini have written enough to show that they might have been among the greatest masters of literature if they had not had other things to do. Italian literature has been continuous, abundantly productive in every century, of unequal merit perhaps, but always affording enough of mark to give it standing, and presenting one name at least the peer of the greatest, and it is of this continuous succession of writings that the present history furnishes a view.

*Brown Men and Women** is the title given by Mr. *Edward Reeves* to a lively, picturesque account of his voyages through the South Sea Islands and of life as he found it there in 1895 and 1896. Mr. Reeves is a New-Zealander, and living, according to distant American perspective, almost among the South Sea Islands, he goes into them in his book without preliminary ceremony, landing the reader, almost at the first leap, among the cannibals of old, whose customs are contrasted with those which prevail in the same regions now. The spirit with which he passes through his adventures and describes them is revealed in his opening sentence: "The South Sea Islands! To us New-Zealanders, when we were young in the sixties, what a charm they were of mystery, barratry, piracy, kidnapping; of tales of innocent, gentle southern natives torn from the paradises and sold into slavery by English-speaking devils; of more northern fierce cannibals, Fijians, New Hebrideans, and Solomon Islanders, down whose throats disappeared, in most satisfactory retribution, some of our compatriots." In a series of running

* A History of Italian Literature. By Richard Garnett. New York: D. Appleton & Co. Pp. 431. Price, $1.50.

* Brown Men and Women; or, The South Sea Islands in 1895 and 1896. By Edward Reeves. London: Swan Sonnenschein & Co. New York: The Macmillan Company. Pp. 294. Price, $3.50.

sketches and stories, like the smoking-saloon yarns of the second chapter, Mr. Reeves gives his experiences and impressions of the Friendly Islands, Tonga and its recent troubled history, "Kava and some Customs," Samoa, the Fijian group, the Cook group, and the Society Islands, adding *obiter* observations and incidents of various sorts, and not by any means omitting solid information. The last chapter relates to the missionaries, and is unfriendly to them.

In a sermon on *The Evolution of a Sentiment—Kindness to Animals in the Christian World*, the Rev. *Newton M. Mann*, of Omaha, argues that the duty of kindness and tenderness to animals is not an original Christian doctrine and is nowhere mentioned in the Scriptures, but is of later development; and that the Hindus long anticipated Christians in enunciating it. (H. S. Mann, Omaha. Five cents.)

The Chemical Publishing Company, Easton, Pa., publishes *Methods for the Analysis of Ores, Pig Iron, and Steel, in Use at the Laboratories of Iron and Steel Works in the Region about Pittsburg, Pa.;* contributed by the chemists in charge, and edited by a committee of the Chemical Section, Engineers' Society of Western Pennsylvania (price, $1). In a circular inviting these articles from chemists the committee defined the aim of the section to be to secure accurate statements of analytical processes, describing with minuteness and clearness the successive steps, in order that the compilation may represent as correctly as possible the present status of analytical chemistry as applied to iron and steel. Sixteen responses were received, detailing the methods pursued at as many furnaces. They are all given in this volume, with an appendix containing various special methods of analysis of ores and furnace products.

Prof. *Alfred Fairhurst*, of Kentucky University, publishes in the volume entitled *Organic Evolution Considered* the objections to the theory of organic evolution that have occurred to him from time to time in the course of his discussions of the subject in his college classes. He finds that organic life can not be accounted for as a function of chemistry, energy, or spontaneous generation; that natural selection does not afford an adequate explanation of the varieties of life, the argument for it is inadequate, and the objections to it are forcible; and "that the lack of harmony in the teaching of evolutionists shows that there is much vagueness as to the details of the theory"; that many difficulties beset the argument from paleontology; failure of the argument from embryology to cover the ground sufficiently; and special objections. Under the head of Several Chapters on Other Subjects included in the book may be placed the chapters on Instincts, The Origin of Man, a Future Life, Design in Nature, Evil and Altruism in Nature, and Agnosticism. The author presents his arguments in good shape and with good temper, but they seem to us to relate to a phase in the discussion that has been passed by both sides. (Published by the Christian Publishing Company, St. Louis.)

The Phylogeny and Taxonomy of Angiosperms was the subject of the address of the retiring president, *Charles E. Bessey*, of the Botanical Society of America, in August, 1897. The author approached the problem by the three lines of investigation—viz., the historical, in which the materials are supplied by phytopaleontology; the ontonogenetic, in which the development of the individual supplies the necessary data; and the morphological, in which the different development of homologous parts supplies our index of relationship.

The principal portion of Part XXXIII of the *Proceedings of the Society for Psychical Research* is taken up with Dr. Richard Hodgkin's Further Record of his Observations of Certain Phenomena of Trance (Mrs. Piper's case). The development of automatic handwriting is considered, and the indications are noted of the truth of the "spirit" hypothesis as against that of telepathy from the living. In a supplementary article Mr. Harlow Gale gives an account of Psychical Research in American Universities.

Another of those clear, practical, wholly readable and wholly comprehensible garden manuals by *L. H. Bailey*, and published by the Macmillan Company, is *The Pruning Book*, a monograph of the pruning and training of plants as applied to American conditions. No prefatory ceremony is observed, but the reader is introduced at once to "the

fundamentals." The philosophy of pruning is explained and illustrated by recording and picturing the history of a branch, and it is shown that pruning does not devitalize plants, but increases vigor by removing that which would perish or be weak in the struggle for existence, and concentrating the nourishment in the rest. The nature and relations of the fruit bud are described, as to different fruit trees; the nature of wounds and the healing of them are treated of in a separate chapter; the principles of pruning are unfolded; and under the heading of the incidentals the details of the art are described, with its special applications to different trees and in "some specific modes of training," and three chapters are given to the grapevine.

We find *The Plant World: a Monthly Journal of Botany*, edited by *F. H. Knowlton*, of the United States National Museum, a work of attractive qualities. The articles in the third number—the only one we have received—are brief, fresh, and to the point, furnished by competent botanists and original observers. The magazine is published by William N. Clute & Co., at Binghamton, N. Y., for one dollar a year.

The *Little Pottery Objects of Lake Chapala, Mexico*, described by Prof. Frederick Starr, in a bulletin of the Anthropological Department of the University of Chicago, consist of vessels, ladles, spindle-whorls of terra cotta, considerable numbers of which were found in the lake, but none in sites on the land. They are too small for any practical use, but are made with much artistic taste and skill. Professor Starr explains them tentatively as votive offerings let down into the water by cords passed through holes provided in most of them, or in which resin or gum may have been burned, or other offerings placed. They are not unique, for the American Museum of Natural History in New York has similar objects from Tillo, Oaxaca, and others are said to have been found near Palenque and near Tehuantepec.

Mr. *William Paul Gerhard*, a distinguished sanitary engineer and writer on the subject, has given in a little book entitled *Sanitary Engineering*, published by himself at 36 Union Square, East, New York, a comprehensive manual of the qualifications and duties of the sanitary engineer, considering the subject wholly from a practical point of view. A course of study in sanitary engineering is described, intended to embrace a general knowledge of civil engineering, architecture, and sanitary science in all their branches; under the head of General Practice of the Sanitary Engineer are given brief directions and hints concerning water supply, sewerage, purity of water courses, sewage disposal, street pavements, street cleaning, removal of ice and snow, removal of refuse, laying out of cities and towns, sanitation of towns and houses, and a variety of kindred subjects; and the appendix includes an article on The Work of the Sanitary Engineer in Time of Epidemics, in Time of War, and in Sudden Calamities in Civic Life.

The Ninth Annual Report of the Interstate Commerce Commission on the *Statistics of Railways* for the year ending with June, 1896, contains the usual reports and summaries of the statistician, a summary of railways in the hands of receivers, notes of decisions, and detailed statistical tables of mileage, corporate charges, receipts and expenditures, etc. But little change is shown from the conditions that prevailed in the year preceding.

In *The Fungous Foes of the Farmer*, a more than ordinarily useful contribution to the Bulletins of the Pennsylvania Department of Agriculture, Prof. *Byron D. Halsted* undertakes briefly to describe the worst fungous diseases of the farmer's crops and to give methods that have been successful in contending with them. As far as possible, the fungi have been considered in the order of their importance with each crop, beginning with those of the field and ending with those of the garden.

The first three volumes of the *Observations made at the Blue Hill Meteorological Observatory* were numbered XX, XXX, and XL, the more easily to distinguish them from the other volumes of the Annals of the Astronomical Observatory at Harvard College; but the system could not be continued indefinitely without leaving too many numbers to be assigned to later volumes not yet published, so the report for 1896 is numbered Volume XLII. The whole of the Blue Hills having been taken by the Metropolitan Park

Commission for a public reservation, a satisfactory arrangement has been made under which the premises of the observatory are reserved to it so far as is necessary for observatory use, so that the continuation of the work is assured, with the expectation that it will ultimately become a part of that carried on directly by Harvard University. At present Mr. A. Lawrence Rotch provides the means for carrying it on. Of the observations recorded in the present report, the most important were those of clouds in co-operation with the international system of cloud observations, and the exploration of the air by means of kites.

The fourth volume, 1896, *Studies from the Yale Psychological Laboratory*, E. W. Scripture, editor, contains articles on Reaction Time in Abnormal Conditions of the Nervous System; Influence of the Rate Change upon the Perception of Difference in Pressure and Weight, and Weber's Law in Illusions, by C. E. Seashore; and on Reaction Time, Voluntary Effort; New Apparatus and Methods, and Psychological Measurements, by the editor, E. W. Scripture. Published at Yale University, New Haven (pp. 141), for $1.

Owing to the large amount of original matter that has lately appeared in the Pharmaceutical Review, and the consequent reduction in other departments, it has been deemed advisable hereafter to publish the more technical scientific articles under a separate cover, to be known as the *Pharmaceutical Archives*. This will be supplied for $1 a year, while the price of the Pharmaceutical Review is $2, and both will be sent for $2.50 a year. The first number of the Pharmaceutical Archives consists of 24 pages, and contains four articles. Published at Milwaukee, Wis. Edward Kremers, editor.

In the *Thirteenth Annual Report* of the Bureau of Labor Statistics of Connecticut, the scope of the investigations has been enlarged as to the inquiry respecting the conditions of workingmen. The readiness manifested by the people in assisting the agents' bureau is recognized. Of the five parts into which the report is divided, the first relates to the condition of workingmen, the second to the condition of manufacturers, the third to the hours of labor and wages in mercantile establishments, the fourth to the rates of wages paid in municipal employment, and the fifth includes an abstract of bills passed or rejected during the last session of the General Assembly and decisions of courts in various States. The operation of the act concerning alien laborers is represented as having been "most beneficial." The services of the State Board of Mediation and Arbitration were not required during the year covered by the report (1897).

The Story of Germ Life, in D. Appleton and Company's Library of Useful Stories, has been prepared by Prof. *H. W. Conn*, of Wesleyan University, one of our most expert bacteriologists, in view of the fact that bacteria are associated in most minds chiefly with disease. "The last few years have, however, emphasized the importance of these organisms in many relations independent of disease, but this side of the subject has not yet attracted very general attention, nor does it yet appeal to the reader with any special force." His purpose, therefore, is to give a brief outline of our knowledge of bacteria and their importance in the world, including, besides their well-known agency in promoting disease, their even greater importance as agents in other natural phenomena. Their nature as plants is described, and their uses in the arts, the dairy, and natural processes are discussed, and the relations of parasitic bacteria to disease and the method of combating them are considered.

The Economic Relations of Life Insurance to Society and State is the subject of Publication No. 218 of the American Academy of Political and Social Science. It includes papers on the subject, read at a meeting of the academy, held in December, 1897, by L. G. Fouse and M. M. Dawson, with discussions by W. D. Whiting, G. E. Freyer, and R. P. Falkner. Published by the academy at Philadelphia, for 35 cents.

N. W. Ayer & Son's American Newspaper Annual for 1898, including its catalogue and accounts of American newspapers and descriptions of towns, etc., in which newspapers are published, forms a volume of 1366 pages, besides those devoted to advertisements. It contains the names of 2,142 publications not found in the previous volume, yet the total net gain is only 137—the smallest, with one

exception, ever yet recorded. Reasons are adduced to show why the gain should not naturally have been larger, but, making full allowance for these, there still seems to have been an unusually large mortality in the newspaper world during 1897. A growing conviction of publishers is noted, "that in a very large number of cases there have been too many newspapers, and that one strong paper is better than two or three weak concerns struggling for existence."

The Passing of Plato, a commencement address by Prof. *O. P. Jenkins*, of Leland Stanford Junior University, celebrates the decay of the scholastic methods and teaching, and the advance of the scientific method to supremacy.

We have received the first number of the *Journal of Applied Microscopy*, *L. B. Elliott*, editor, published monthly by the Bausch and Lomb Optical Company, Rochester, N. Y. It is intended to supply what is believed to be a want of the country, of a journal devoted to microscopical instruments and technics, regarded from the practical point of view. It is to be conducted on an entirely independent basis. Subscription price, $1 a year.

An important paper on *Road Materials and Road Building* has been prepared by Dr. *Frederick H. Merrill*, director of the New York State Museum, and is published by the University of the State of New York. In it the problem of road improvement in New York, and the character and value of the material in the State available for road making, are discussed, directories of producers of road material and quarrymen are given, and liberal citations are made, largely as to the methods of construction, from the reports of the Massachusetts Highway Commission. Two pocket maps show the distribution of rocks in New York suitable for road material and the location of quarries; and more than a dozen photographs illustrate what has been done in Massachusetts.

PUBLICATIONS RECEIVED.

Agricultural Experiment Stations. Bulletins and Reports. Cornell University: No. 147. Fourth Report upon Chrysanthemums. By Wilhelm Mutler. Pp. 36.—Indiana: Report of the Botanical Department. By J. C. Arthur. Pp. 10.—Michigan: No. 157. Hog Cholera. By G. A. Waterman. Pp. 8; No. 158. Some Experiments with Poultry. By C. D. Smith and C. S. Brooks. Pp. 16.—Ohio: Peach Trees. Pp. 192; Newspaper Bulletin, No. 183. Cucumbers, Melons, Tomatoes, Peach Trees, and Weeds. Pp. 2.—Purdue University: Special Bulletin on Commercial Fertilizers. By H. A. Huston, State Chemist; No. 65. Formalin for Prevention of Potato Scab. By J. C. Arthur. Pp. 16.—United States Department of Agriculture: No. 15. Forest Growth and Sheep-raising in the Cascade Mountains of Oregon. By F. W. Coville. Pp. 54; No. 16. Forestry Conditions and Interests of Wisconsin. By Filibert Roth, with a Discussion by B. E. Fernow. Pp. 76; No. 22. Climate of Cuba; also a Note on the Weather of Manila. By W. F. R. Phillips. Pp. 23; North Dakota Weather and Crops. By B. H. Bunson. Pp. 8.

Britton, N. L., and Brown, Hon. Addison. An Illustrated Flora of the United States, Canada, and the British Possessions. Vol. III. Apocynaceæ to Compositæ (Dogbane to Thistle). New York: Charles Scribner's Sons. Pp. 588. $3.

Bulletins, Reports, etc. Harvard College Observatory: The Meteoric Shower of November 13, 1897. By William H. Pickering. Pp. 16, with plate.—Johns Hopkins University Circulars: Notes from the Physical Laboratory. Pp. 16. 10 cents.—Minnesota: Third Annual Report of the Chief Fire Warden. 1897. Pp. 80.

Conant, Franklin Story. A Biographical Sketch and Memoir on the Cubomeduse (a memorial volume). Baltimore: The Johns Hopkins Press. Pp. 62, with portrait and 8 plates.

Crook, James W. German Wage Theories. History of their Development. Columbia University (Studies in History, Economics, and Public Law). Pp. 113. $1.

Elliott, A. G., Editor. Industrial Electricity. Translated and adapted from the French of Henri de Graffigny. New York: The Macmillan Company. Pp. 149.

Fairlie, J. A. The Centralization of Administration in New York State. Columbia University (Studies in History, Economics, and Public Law). Pp. 207. $1.

Haddon, A. C. The Study of Man. New York: G. P. Putnam's Sons. Pp. 410.

International Correspondence School. What Correspondence Instruction is. Scranton, Pa. Pp. 24.

Lange, D. Handbook of Nature Study for Teachers and Pupils in Elementary Schools. New York: The Macmillan Company. Pp. 329. $1.

MacEwan. The Essentials of Argumentation. Boston: D. C. Heath & Co. Pp. 412. $1.12.

Mathews, F. Schuyler. Familiar Life in Field and Forest. The Animals, Birds, Frogs, and Salamanders. New York: D. Appleton and Company. Pp. 284. $1.75.

Miller, John. The School System of the State of New York (as viewed by a Canadian). Toronto: Warwick Brothers & Rutter. Pp. 204.

New Jersey, Geological Survey of. The Physical Geography of New Jersey. By R. D. Salisbury, with Appendix by C. C. Vermeule. Trenton. Pp. 200, with plates.—Also, accompanying this, a Relief Map of New Jersey, 24 × 42 inches, with name-sheet

New York Academy of Sciences. Vol. XI. Part. I. G. Van Ingen, Editor. Pp. 135, with plates.

Parker, F. W., and Helm, N. L. Uncle Robert's Geography. II. On the Farm. New York: D. Appleton and Company. Pp. 158. 40 cents.

Rasius, C. E. Rechte und Pflichten der Kritik (Rights and Duties of Criticism). Leipsic: William Engelmann. Pp. 171.

Reprints. Bessey, C. A. and E. A.: Further Notes on Thermometer Crickets. Pp. 2.—Black

well, Rev. A B.: Consciousness and its Helpers. Pp. 6.—Craig, C. T.: Neurotic Lithemia. Danbury, Conn. Pp. 3.—Fernald, M. L.: The Genus Antennaria in New England. Pp. 12.—Fewkes, J. Walter: The Winter Solstice Ceremony at Walpi. Pp. 38.—Fuller, M. L.: Notes on a Carboniferous Bowlder Train in Eastern Massachusetts. Pp. 12.—Hale, F. E.: Treatment of the Uric-Acid Diathesis. Pp. 7.—Van der Water, G. R., D. D., and Beaman, C. C.: Anniversary Addresses at Babies' Wards, New York Post-Graduate Medical School and Hospital. Pp. 12.—Watson, L. H.: Uracidemia. Pp. 3.—Winter, H. L.: Notes on Criminal Anthropology and Bio-Sociology. Pp. 37, with plates.

Rice, Wallace, and Eastman, Bassett. Under the Stars, and other Verses. Chicago: Way & Williams. Pp. 64.

Rowley, John. The Art of Taxidermy. New York: D. Appleton and Company. Pp. 244. $2.

Sloyd Bulletin. Monthly. No. 1. May, 1898. Boston: Sloyd Training School. Pp. 40.

Smithsonian Institution: Review and Bibliography of the Metallic Carbides. By J. A. Mathews. Pp. 32.—Revision of the Deep-Water Mollusca of the Atlantic Coast of the United States, etc. By A. E. Verrill and K. J. Bush. Pp. 132, with plates.

Still, Alfred. Alternating Currents of Electricity and the Theory of Transformers. London: Whittaker & Co. New York: The Macmillan Company. Pp. 184. $1.50.

Taylor, A. R. The Study of the Child (International Education Series). New York: D. Appleton and Company. Pp. 215.

Thomas, Prof. Cyrus. Introduction to the Study of North American Archæology. Cincinnati: The Robert Clarke Company. Pp. 408. $2.

United States Coast and Geodetic Survey. Notice to Mariners. No. 232. May, 1898. Pp. 10.

Washburn, F. L. Preliminary Report upon the Introduction of the Eastern Oyster to the Oregon Coast, Summer of 1897. Pp. 4.

Whitten, R. H. Public Administration in Massachusetts: the Relation of Central to Local Activity. Columbia University (Studies in History, Economics, and Public Law). Pp. 167. $1.

Fragments of Science.

BALNIBARBIAN GLUMTRAP RHYME.

*(Repeated by the children in the nurseries of Balnibarbi.)**

DISTANT scintillating star,
Shall I tell you what you are?
Nay, for I can merely know
What you were some years ago.

For, the rays that reach me here
May have left your photosphere
Ere the fight of Waterloo—
Ere the pterodactyl flew!

Many stars have passed away
Since your ether-shaking ray
On its lengthy journey sped—
So that you, perhaps, are dead!

Smashed in some tremendous war
With another mighty star—
You and all your planets just
Scattered into cosmic dust!

Strange, if you have vanished quite,
That we still behold your light,
Playing for so long a time
Some celestial pantomime!

But, supposing all is well,
What you're made of, can I tell?
Yes, 'twill be an easy task
If my spectroscope I ask.

There—your spectrum now is spread
Down from ultra-blue to red,
Crossed by dark metallic lines,
Of your cooler layer the signs.

Hence among the starry spheres
You've arrived at middle years—
You are fairly old and ripe,
Of our solid solar type.

Ah, your sodium line is seen
Strongly shifted toward the green.
Hence you are approaching me
With a huge velocity!

But, if some celestial woe
Overtook you long ago,
And to swift destruction hurled
Life on every living world,

Did there in the fiery tide
Perish much of pomp and pride—
Many emperors and kings,
Going to do awful things?

Mighty schemes of mighty czars—
Mighty armies, glorious wars!
From the Nebula they may
Rise to curse a world some day!

G. M. MINCHIN.

—From Nature of April 14, 1898.

* Balnibarbi is one of the countries visited by Gulliver; the "Glumtrap" is the Balnibarbian equivalent of the English nursery; and the babies of Balnibarbi are brought up on strictly scientific principles—as is evidenced by their knowledge in these verses.

The Total Eclipse at Vizladrug.—The following vivid description of the recent total eclipse of the sun appeared in the Times of India: "But high overhead was a sight it was worth a journey of thousands of miles to see. In the midst of the dull blue sky stood out the inky blackness of the moon with its slightly ragged edge, a silhouette more sharply defined than the mind can conceive. Encircling the moon was the corona, a mass of the purest and most brilliant incandescence, thin in the upper portions, and much broader below. On the lower left corner a blazing blood-red prominence cast a ray of beautiful color into the dazzling whiteness; a smaller and less conspicuous spot appeared upon the opposite quadrant. At the second of totality four extensions leaped from the corona into the surrounding darkness, feathery, ethereal streams of the most exquisite pearly luminosity. To the southward Venus shone with the brilliance of a tropical night; below her, Mars less clearly, and three stars of lesser magnitude were barely visible. The darkness, owing to the great clearness of the atmosphere, was not intense. Newspaper print could be easily read, or the position of the second hands of a watch noted without the assistance of a lantern. Still the landscape presented an unnatural appearance, and irresistibly suggested a world seen through a colored glass. Away to the westward the horizon was a dull gray purple, shading into a delicate violet, and then to a lovely subtle yellow like the tinge of an English winter sunset; to the east the shadow of the moon seemed to envelop the earth like an angry rain cloud. There were few opportunities of observing the effects of the eclipse upon the animal world. A number of crows circled restlessly over the trees which fringe the little sandy bay; a big yellow snake half crawled out of his hole near the wall, looked round, and withdrew. Other sign of animal life there was none."

The Field Columbian Museum.—The work of the Field Columbian Museum, Chicago, during the year covered by its last annual report, included two courses of eight lectures each, in one of which distinguished specialists were represented, while the other was given entirely by the curators of the museum; and the publication of seven works of research (in addition to the annual report) of great value. The library contains 8,062 books and 7,680 pamphlets. A large space in the report is occupied with the description of the accessions to the various departments of the museum, which are catalogued in another part of the book. All the agencies employed have given excellent returns, and all the departments seem to have shared in the results. The collection obtained by the African expedition of Mr. Elliott (to the Masai country) is very valuable, "probably the most important, certainly so as regards quadrupeds, ever brought out of any country by one expedition"; and consists of about two hundred animal skins, three hundred skins of birds, numerous reptiles, and about half a barrel of fishes, obtained on the coast and at Aden. Skeletons of every species, in certain cases two or three of the same species, were preserved, and casts of heads and parts of bodies showing the muscles of the large animals were made. Specimens forming a fair representation of the materials in use among the tribes were obtained, with photographic negatives of the people, scenery, and animals. Other expeditions were made by Messrs. G. A. Dorsey and E. Allen among the Indians of the far West; Mr. O. C. Farrington to the caves of Kentucky; Mr. C. F. Millspaugh for forestry specimens; and the assistant curator of ornithology for southern birds.

The Climate of Alaska.—An article by General A. W. Greely on climatic conditions in Alaska, in The National Geographic Magazine, is authority for the following statements: Almost everywhere in Alaska the climate changes decidedly within a hundred miles of the mainland coast and becomes continental in its characteristics. Rain and snow are less frequent, the summers are longer and warmer as we go inland, the skies less cloudy, and the winters marked with excessive cold. Freezing weather, usually below zero, continues for months, and even in July, with midday temperatures of 70° to 80°, it is an almost daily occurrence for the temperature to fall during the night to the neighborhood of the freezing point. Sitka is a typical coast station for southern Alaska. In forty-five years its temperature has varied between 88° and —4°. The cold-

est month is January, 31.4°, and the warmest August, 54.9°. Every year it is either rainy or snowy two hundred days on an average. The annual rainfall is very great, being eighty-one inches. Point Barrow, the extreme northern point of Alaska, is in 71° 23′ north, 156° 40′ west, and its climate is that of the coast line of the whole timber or moorland region situated along the Arctic Ocean. The winter is long, freezing weather lasting from early September to early June. The mean winter temperatures are December, —15.4°, January, —17.5°, and February, —18.6°, with occasional periods when the cold is from 40° to 52° below zero. The average heat of July is 38.1°, but the temperature often rises above 50°, and has touched 65.5°. The snowfall is light. The severity of the cold is indicated by the fact that the ground was found frozen as far as excavations were made (thirty-eight feet). Temperature observations at Dawson, in the Klondike region, during the fifteen months from August, 1895, to November, 1896, show the following records: In July only the temperature did not sink below freezing. During June, July, and August, 1896, the temperature rose on twenty-nine days above 70° and thrice above 80°. The extreme severity of the winter is indicated by the fact that from December 1, 1895, to February 1, 1896, the temperature fell below zero every day. On twenty-eight days it fell lower than —40°, on fourteen days lower than —50°, and on nine days lower than —60°. The average temperature for January, 1896, was —40.7°, and for February —35.4°. Bright weather is the rule. The Yukon River broke up on May 17th. It was frozen solid November 25th.

The Holophane Globe.—The results of an inquiry by a committee of the Franklin Institute into the efficiency of Blondel and Psaroudaki's holophane globes are printed in that body's journal for April. The object of the holophane globe is "to secure diffusion of the light, as well as such a form of distribution that the light usually lost by being sent off into space above the source of light shall be distributed below that plane and thus made useful." In the globes under consideration the interior surface is made of a continuous series of vertical flutings. The function of these flutings is to secure a distribution normal to the direction of the incident light. The external surface of the globe consists of a series of circular grooves in a horizontal plane extending over the entire surface of the globe. These grooves are constructed with reference to the relative positions of the groove and the source of light. The committee reported that when the light from an arc lamp passed through the globe, the effect upon a vertical screen showed a distinct cutting down of the amount of light passing in a straight line through the upper part of the globe, and a definite increase of the light on a horizontal plane and at all angles below that plane, the space vertically beneath the globe being well illuminated. The fact that the diffusion is secured is shown by the character of the shadows cast. When an opaque body is held near the globe there is practically no shadow on a screen a few feet away. This property of the globe has the effect of entirely doing away with distinct shadows of bodies near it that is so objectionable in the ordinary arc light. In appearance the holophane globe is covered with bright points over its entire surface. Recent tests by Professor Lewes, of London, with a Welsbach mantle and one of these globes showed that in the angle between the horizontal plane and forty-five degrees below it the holophane globe increased the light from twelve to thirteen per cent, while the best of a number of others examined, a clear glass globe, gave a loss of 7.5 per cent. The general conclusions by the committee regarding the globe were that "Messrs. Blondel and Psaroudaki have invented a globe that secures much better diffusion and more satisfactory distribution than any other globe known to its members; that the conditions of its manufacture are such that it can be supplied to the trade in commercial quantities; and that the invention has secured a distinct improvement in the diffusion and distribution of artificial light." The committee recommended that the John Scott Legacy medal and premium be awarded to the inventors.

Epicurean Cats and Dogs.—While most instances in which eccentricities of animal tastes have come under observation are those in which animals, like dogs and cats, are

taught to relish other than their usual food, cases are cited by M. C. Cornevin in which animals usually carnivorous spontaneously seek vegetables and fruits. A group of well-fed dogs came under his observation which manifested an epicurean taste for plums. He often found them in his morning walks in the orchard, they having crept through the holes in the fence, snapping at the fruit that had fallen off during the night. One of them, when offered bread soaked in bouillon and plums, took the plums. Another dog did not lose his appetite for the fruit when stung by a wasp concealed in a plum, but afterward turned every plum carefully over and examined it before biting it. The dogs seemed to prefer sweet fruits; they liked pears as well as plums, and the choicest varieties best. The author was told that shepherds who trade in dogs' skins have found that they got the best prices for the skins of animals that are slain in October after having been fed on fruit during the summer, and that the meat of such dogs had been found to be palatable and destitute of the usual unpleasant flavor. Cats were observed to be fond of melons, and to manifest a decided taste for cooked vegetables, especially leeks and onions. They will abandon for a time the meats given them with their dinners and eat the vegetables only. They are not fond of raw vegetables except asparagus, of which they have been known to keep the young shoots well down by biting off the tips as they appear. A cat is mentioned, however, that lived one summer chiefly upon beans in the pod; and another that spent the whole season in the garden, beginning with the asparagus bed, then taking to green beans, which he pulled down from the trellises that supported them; and next on carrots, of which he ate the tops down to the ground, but did not scratch the soil from the root. This cat would have led the same kind of life a second season, but, being as destructive to the garden as a rabbit, was shot. The fierce and carnivorous marten and weasel enjoy cherries, and become fat and hearty upon them. These peculiarities, and the fruit hunting of foxes, skunks, and bears, have been accounted for by some naturalists as induced by hunger; but the explanation is not sufficient. The tastes are manifested when food of all kinds is most abundant and most easily obtained. A more probable explanation is that they are atavistic reversions, or are adaptations to peculiar conditions of the digestion and its ferments, demanding the introduction of new agents to re-enforce those already at work, but which may have become enfeebled. The subject is a good one to experiment upon.

Revaccination. — The following paragraph is taken from a "memorandum" recently prepared by Dr. Bond for the Jenner Society in England: "The experience of every epidemic, and last but not least of that of Middlesbrough, shows conclusively that if we wish to protect the community against these increasingly frequent scourges we must take as much trouble to promote revaccination as we have hitherto taken to promote infant vaccination. So long as the public are led to believe, as they have been hitherto, that vaccination in infancy is the only thing about which the state need take any care, so long will epidemics of so-called 'vaccinated' adolescents and adults and of unvaccinated or badly vaccinated children be the opprobrium of our country. There is only one way of effecting this, and that is by requiring, so far as is practicable, every child who enters a school to be efficiently vaccinated, and that before it leaves school it shall be equally efficiently revaccinated. It is to the revaccination of her adolescent population that Germany owes the remarkable immunity from epidemics of smallpox which she has for the last twenty years enjoyed rather than to her compulsory vaccination in early childhood, for it is the adolescents and adults whose early protection in infancy has become attenuated by age who are most exposed to the risks of smallpox. If we can secure their protection by revaccination at the end of the school age, as well as that of the children at the commencement of it, we need not trouble ourselves much about the infants. We have been misled in this respect by false inferences from the experience of Jenner and the early vaccinators. When infants were the chief sufferers, because the adult population was in a large degree protected by having had the disease, the discovery of a means by which these unfortunate little victims could be almost absolutely protected naturally led to an undue estimate of the value of infant vaccination, especially

as its effects were assumed to be more lasting than they really are; but we have now to deal with altogether changed conditions. Where infant vaccination is fairly well maintained, as it has been in Middlesbrough, it is the adults who have not been revaccinated who are now the chief source of danger—a danger which can only be avoided by investing every young person with the same degree of protection which we have for the last half century conferred upon the greater portion of our infant population."

The Eskimo Lamp.—Mr. Walter Hough, in The American Anthropologist for April, gives an interesting account of the Eskimo lamp, which is, it seems, the most important utensil of the latter's household. There are many drawbacks to the spread of a people into arctic regions—the cold, the long nights, the hardships of travel, scarcity of wood, and, paradoxical as it may seem, the difficulty of obtaining drinking water. This latter drawback is the most serious of all, and were it not for the Eskimo's lamp would have effectually prevented his settlement in arctic regions. The typical Eskimo lamp is a shallow dish of soapstone with the outline of the gibbous moon. It has hollowed out on the upper surface a reservoir to contain oil. The rear is curved and bounded by a low wall. The reservoir slopes gradually up to the edge upon which the wick is laid. This edge is straight. The wick is of moss, rubbed to powder between the hands, and carefully laid in a thin line along the wick edge of the lamp. The oil in the reservoir stands just at the lower margin of the wick. The flame is about two inches high, and is clear and smokeless if the wick is properly cared for. The oil is supplied by blubber melted by the heat of the lamp. With this contrivance the Eskimo lights and heats his house, cooks his food, and melts snow for his drinking water. The lamp is peculiarly the possession of the women. Each head of a family must have a lamp, though two or more families may live in the same hut. The Eskimos have no phrase expressing a greater degree of misery than "a woman without a lamp." After the death of a woman her lamp is placed upon her grave. The lamp is only useful with fats of high fuel value, such as are furnished by fish and seals. The wick line is found to increase in length toward the north. In southern Alaska this edge is about two inches long, while at Point Barrow, the most northerly point of Alaska, it is from seventeen to thirty-six inches in width. In fact, this variation is so uniform that by examining the wick edge a fairly close estimate of the latitude in which a lamp originated can be made.

Popocatepetl.—Popocatepetl, "the smoking mountain," and Ixtaccihuatl, "the white woman," are the highest peaks of a mountain range or sierra about sixty miles in length and eighteen in breadth, called the *Sierra Nevada*, or Snowy Sierra of Ahualco, which constitutes a barrier separating the valley of Puebla from the valley of Mexico. Communication is had between the valleys by a saddle-shaped pass, the lowest point of which is twelve thousand one hundred and eighteen feet high. Popocatepetl, the fourth highest mountain in North America, is a volcano with a snow-capped lava cone, which is now in the solfatara state, emitting only steam and sulphur. It is frequently ascended, although it is between seventeen thousand and eighteen thousand feet high, and rises about five thousand feet above the snow line. One of the grandest mountains of the continent and presenting a magnificent aspect from every point of view, its pride has been sadly mortified by its having been reduced to be a sulphur mine. The sulphur, which is obtained from the crater, is mined in June and July, those months being chosen with reference to the quantity of snow, which is then sufficient to allow of making a smooth trough on which the sulphur can be slid from the crater to the ranch of Tlamacas, five thousand feet below. The general features of the ascent, as Dr. O. C. Farrington describes his achievement of it in February, 1896, in the Bulletin of the Field Columbian Museum, are not strikingly different from those presented in the ascent of other not extremely difficult snow mountains. The lower slopes of the snow are broken up by long tongues of exposed sand on which the climbing was comparatively easy, but in the last stages every step had to be cut in the ice. The ice and ashes are very destructive to leather, so that a single

ascent is enough to wear out a pair of shoes. The snow is rarely more than a few feet deep, but is cut up on the surface into numberless rough, wedge-shaped teeth, and is constantly dissolved at the bottom by the warm ashes beneath it. "Nothing like crevasses occur in the snow, and the yawning chasms reported by travelers or would-be travelers can be set down as purely imaginary." The approach to the crater was signalized by a strong odor of hydrogen sulphide that filled the air. The crater is about two thousand by thirteen hundred feet in diameter, and from eight hundred to fifteen hundred feet in depth, with nearly perpendicular walls from which jets of steam come hissing and sizzling, and rocks of various sizes are continually falling and plunging with a roar to the bottom. This bottom is heaped unevenly with *débris* of various sorts and colors; and, as Mr. Farrington had to look down into it with a wind so fierce that it caused the very walls to tremble, its aspect was dismal enough. There is none of the heat and movement usually associated with volcanic eruptions, for that phenomenon here is very mild indeed. Various parts of the crater rim have been named the *Pico Mayor*, or highest point; *El Portezuelo*, or Little Door; *El Espinazo del Diablo*, or Devil's Backbone; and *El Malacate*, the windlass, where the sulphur gatherers are let down. The layers of lava of which the walls of the crater are made are plainly visible at intervals, dipping at various angles.

A New Theory of Geyser Formation.—At a recent meeting of the Physical Society at Eton College, Prof. T. C. Porter discussed a new theory of geyser formation, which is reported as follows in the Chemical News: "The theories of Bunsen and others fail to explain why the geyser throat appears almost completely full at the end of an eruption. This immediate refilling is the more remarkable when it is remembered that some of the geysers of the Yellowstone region discharge a million and a half gallons at each eruption, and that the eruptions may occur at five-minute intervals. Moreover, the theories generally accepted assume steeper temperature gradients than those in a region like Yellowstone. Professor Porter suggests that the phenomena are better explained on the assumption of an arrangement of strata such as exists in artesian-well districts; the throat or shaft of the geyser being in the position of a well communicating with a subterranean stream—the 'tube' of the geyser. From the disturbed nature of the region, the tube of the geyser follows a waved course. The 'shaft' rises from the crest of the terminal wave; the other crests may be steam traps. Since a basinlike formation is characteristic of all geyser regions, it is fair to assume that the end of the tube remote from the shaft has an outcrop in the hills that form the sides of the basin. By means of this outcrop, water continually flows into the tube. Where the tube does not sink deeply enough to attain the temperature necessary for the generation of steam, a quietly flowing hot spring is the result. But if at any point the tube descends to underground temperatures sufficiently great, steam is formed, and is trapped at the highest point of a bend. Ultimately this steam checks the flow of water, until the accumulated head of cool water from the hills overcomes the resistance, condenses the steam, and re-establishes liquid continuity. Urged by the pressure behind it, the steam is impelled toward the geyser throat; it forces the hot water before it until equilibrium is once again restored in the tube."

Materials for Paper Making.—One of the most important considerations in the selection of materials for paper making is that of the structure of the fiber. The most perfect spinning fibers, and the best for paper making, are cotton and flax. They differ in that cotton—unique in that respect—occurs in the form of ultimate fibers and is a spinning unit, while flax is composite, or a bundle of ultimate fibers or spinning units. Next to flax are rhea, inferior on account of the irregularity of its fibers; hemp and jute, which have distinct qualities. After these are the fibers used in twine and rope making, but not adapted for spinning. All may be used in paper making, with various results in the quality of the product. Another important item bearing upon paper material is the chemical composition of the fiber, or its capacity of resistance to the natural agencies of destruction. This is the living question in modern paper making. In this point cot-

ton and linen rags stand at one extreme and wood pulp at the other. The destructive agents are oxygen, the action of which is stimulated by resins used in sizing the paper; water, which provokes chemical changes that are facilitated by acid substances present in the sizings; and living organisms—molds and bacteria—which become more dangerous than ever when gelatin is introduced into the sizing. Paper must further possess mechanical qualities to enable it to endure—strength, a certain degree of elasticity, and resistance to rubbing and friction—all of which are involved in the questions of material and sizing. Then all papers are "filled" or "loaded," generally with clay, to give them "body" and opacity and to cheapen the manufacture. This does not actually injure the paper, but may be carried to such an extreme as to be a cheat. The best papers, and the only ones suitable for use in permanent records, are those made of what Messrs. Cross and Bevan, in their book fully treating of the subject, call normal cellulose—cotton and linen—with china clay only sparingly used. Such papers are now, unfortunately, rare. China clay is prodigally used, and wood and straw largely take the place of rags. Papers made of these substances are very inferior and perishable. They are easily liable to discoloration, oxidize readily and gradually crumble, rot, and perish—a fact of which any one may satisfy himself by looking at some newspaper cuttings only a few years old. The conclusion is drawn by Mr. C. F. Cross, from the examination of specimens of serial publications in various European languages, that "a large proportion of the literary and scientific work of the age is printed on an extremely perishable foundation." Happily, publishers have become aware of this deficiency of modern papers and are exercising more care in the selection of those to be used in their better works; and manufacturers claim that with improved processes and better methods they are able to make even wood paper that will last.

More New Elements in the Atmosphere.—In communications to the French Academy of Sciences and the Royal Society, Prof. William Ramsay has reported the discovery by himself and Mr. M. W. Travers of still other hitherto undetected elements in the atmosphere. The author, having obtained a quantity of liquefied air from Dr. Hampson, allowed it to cool and evaporate slowly till only about ten cubic centimetres remained out of the original quantity of seven hundred and fifty cubic centimetres. The gas obtained from this residue was then carefully purified from oxygen and nitrogen, and when examined spectroscopically showed the argon spectrum freely and also another spectrum which was believed never to have been seen before, especially characterized by the presence of two very brilliant lines, one in the yellow, close to but not identical with the helium line, and another in the green. Other lines were also seen, but they were much less intense. The new spectrum is under special study by Mr. Baly. The newly discovered gas is less volatile than nitrogen, oxygen, and argon, and heavier than argon, having a density measured at 22.5 as compared with hydrogen, but likely to prove greater when it is obtained free from argon. The ratio of its specific heats indicates that it is monatomic, and therefore an element. Professor Ramsay proposes for it the name *krypton* (concealed) and the symbol Kr. In a subsequent communication to the Royal Society, Professor Ramsay and Mr. Travers reported that on submitting argon to liquefaction, a colorless liquid was obtained with a white solid substance condensing partly around the sides of the tubes and partly below the surface of the liquid. A gas was obtained from the liquid by distillation and collected in two fractions. The spectrum of the gas was characterized by a number of bright red lines, one of which was particularly brilliant, and a brilliant yellow line, while the green and blue lines were numerous but not conspicuous. The measured wave length of the yellow line showed that it is not identical with those of sodium or helium, which equal it in intensity. Density measurements gave 17.2 for the first fractionation and 14.7 for the second—a result that encourages hopes that when obtained in greater purity it may have the density of about 11 requisite to give it a place in the periodic table. The name *neon* is proposed for this new gas. The white solid substance which was obtained with the liquid argon volatilized slowly, but on wiping off the coating of snow from the bulb with the finger was seen to

melt and volatilize into the gas holder. The resultant gas when introduced into the vacuum tube showed a very complex spectrum, totally different from that of argon, while resembling it in general character. Its density was found to be 19.87. Inasmuch as it differs in a very marked degree from argon in its spectrum and in its behavior at low temperatures, it must be regarded as a distinct elementary substance. It would appear to hold the position toward argon that nickel does to cobalt, having approximately the same atomic weight, yet different properties. It is monatomic. In a sealed package deposited with the French Academy of Sciences, May 11, 1898, and opened when Professor Ramsay's communication on krypton was read, MM. Moissan and Deslandres announced the discovery of a new gas in the atmosphere resembling nitrogen but different from krypton.

MINOR PARAGRAPHS.

THE best existing illustration in this nineteenth century of the stone age and what it was like, Mr. W. S. Lach-Szyrina said, in a paper read in the British Archæological Association, is to be found in Australia. The Tasmanians, now extinct, were considered the best representatives of the men of the early stone age, and the still existing Australian races—making allowance for different climatic forces—furnish some of the best representatives of mankind of the later stone age. Some information respecting the difficult subject of the habits of thought of the people of the stone epoch may be gleaned from a comparison of the folk and legendary lore of Australia and that of the countries of southern Europe. In Australian folklore a great confusion is apparent between human beings and animals; and in the folklore of Cornwall the remains of a very primitive folk-belief in the transmigration of men and women into animals, and *vice versa*, have lingered almost to our own day. Similarities may be traced between the folklore of Australia as it appears in Mrs. Langloh Parker's Australian Legendary Tales and that of Britain as regards the belief in spirits and the influence of the stars; and curious resemblances occur between our nursery tales and the legends of Australia.

THE great number of Norse words in the dialect of the Shetland Islands—ten thousand—is accounted for by Dr. Jakob Jacobsen by the fact that the islands were colonized in the ninth century from different districts of Norway, where numerous dialects prevailed. Consequently, every district, parish, and island has a number of Norse words peculiar to itself. Synonyms, moreover, are very abundant in popular speech. A few nursery rhymes, riddles, and proverbs in Norse are still preserved, though in very corrupt shape. A curious system of taboo, reminding us of similar customs in some of the South Sea islands, and coming down from pagan times, prevails in these islands and farther south, by which, at the deep-sea fishing, everything has to be called by some mystic name. The minister and church are on no account to be mentioned by their right names at sea. They represented in the pagan days "the new conquering faith which aimed at doing away with the old gods, and consequently at diminishing the sea god's dominion of the sea. Being thus offensive to the sea god and the sea spirits, the church had to be called *de Benihoose*," or the prayer house, and the minister *de upstander* or *de beniman*, or prayer man. Other names were also given him, as *de predikanter*, or preacher, and *de loader* (from an old word meaning to utter sounds or speak in a peculiar tone), and in one island *de hoideen*. The little island of Fetlar, not seventeen square miles in area, has about two thousand place names.

A DERIVATION is found by Mr. Guy Le Strange for the word *tabby* as applied to the cat, which is indeed strange enough. The name comes originally, it appears, from Attāb, a great-grandson of Ommayyeh, of the family of caliphs, whom Mohammed appointed, A. D. 630, governor of Mecca. When afterward Bagdad was built and made the capital, certain lands in the city were assigned to the descendants of Attāb and became the Attābiyeh quarter. This quarter became famous for its silk looms, and the goods called Attābī, woven in variegated colors of mixed silk and cotton, were exported to all parts of the Moslem world, and were imitated in other places, as in Almeria, Spain, where eight hundred looms were kept

at work upon it. The material was sent into all Christian countries, and its name is found in most European languages. Queen Elizabeth was *vestita di tabi d'argento et bianco* (dressed in silver-and-white tabby) when she received the Venetian envoy Scaramelli in 1602. Samuel Pepys records of a certain day that he put on his "false taby waistecoate with gold lace." And Miss Burney, on the occasion of the birthday of the princess royal, at Windsor, in 1786, appeared in a gown of "lilac tabby." Dr. Johnson explains in his dictionary that tabby is "a kind of waved silk," and adds that the tabby cat is so named from the brindled markings of its fur.

THE "pine-barren region" of the Atlantic coast, sporadic and narrow in New England and Long Island, broadens as we go south, and in the Carolinas often extends to a distance of about eighty miles from the sea. It has a flora of its own, and quite distinct from those of the hill and mountain regions back of it. Mr. Thomas H. Kearney, Jr., reports in the new periodical The Plant World that he has found spots where a large proportion of this flat-country flora occurs in nooks of sandy ground hidden away among the high regions of the Appalachians. Especially along the French Broad River, in East Tennessee and western North Carolina, "there is a notable incursion of plants usually considered typical of the coastal plain. In some places these 'miniature pine barrens,' with their growth of pitch and scrub pine and the herbaceous plants that associate themselves with them, push their way up on the lower, near-by ridges, crowding among the oaks and chestnuts that are the rightful tenants. Such islands of coastal vegetation have been observed at several places in this mountain region."

EVERY one is acquainted with those water plants, the duckweeds, which appear to the eye as small oval leaves floating on the surface of ponds and streams, so closely packed together as to form an apparently continuous mass, often of considerable extent. Mr. Charles Henry Thompson, who has made a study of them, finds four well-defined genera and about twenty eight species in their order, the *Lemnaceæ*, distributed throughout the torrid and temperate zones. In our range the four genera are represented by about thirteen species and one variety, of which two species and the variety are probably peculiar to it alone, and ten are found only in the western hemisphere. There are difficulties in classifying them, because the species have a strong tendency to vary widely according to the surroundings, and because the flowers and fruit are only partially known in some species and not at all in others. Then some species may have two or three marked stages of growth differing from each other so widely as to give rise to different specific names for each. In the third of these stages, which the author calls the "resting stage," "winter fronds" are formed, and the plant sinks to the bottom, to rise again in the spring. Somewhat similar modified fronds are formed when the ponds recede or dry up, to start out again in healthy vegetation when the moisture returns.

NOTES.

A VERY interesting excursion is offered by La Nature to its subscribers, from the 4th till the 16th of August, to the central plateau of France, with its caves, gorges, and mountain ascents. An itinerary has been prepared contemplating a visit each day to some of the remarkable and curiously attractive spots in which the region abounds, including an experience of subterranean navigation in the *Gouffre* of Padisac, the *Gouffre* of Réveillon, the mines and factories of Decazeville, the buried forest of la Mougudo, the viaduct of Garabit, the *Course du Sauveterre*, navigation of the Gorges of the Tarn, the Grotto of Dargillan, and ascensions of the Puy Mary, with lunch on the summit, and of l'Aigoual. The entire cost of the excursion, covering all ordinary expenditures, is two hundred and fifty francs, or fifty dollars, from Rocamadour, where it begins, to Vigan, where it ends, with reduced railroad fares going and coming.

DR. STUART JENKINS has not been satisfied with the adequacy of the Darwinian doctrine of descent and natural selection. He is peculiarly struck with its failures to explain the infertility of hybrids and to fill the gap between the invertebrates and the vertebrates. After several years of independent study and investigation of the subject, he has published his conclusion in an elaborate article in the Medical Age that "the vertebrate organism, instead of being a single organism which has been evolved from a simple to its present highly complex form by a gradual and cumulative differentiation, is in fact a compound made up of two distinct organisms constantly associated; . . . that the divergence of the vertebrates from the

lower type was caused by the plantation of one organism of the ganglionic type upon another, the implanted organism giving rise to the cerebro-spinal nerve system and internal skeleton." The author further believes that the ganglionic type is itself a compound, the ganglions being parasitic on a simple cellular matrix.

A RESOLUTION passed by the American Association at its Detroit meeting suggested, as a remedy for the obstacles imposed on the interchange of scientific thought by the prevailing diversity of tongues, the adoption by the civilized nations of an alternate language of Learning, Law, and Commerce, to be taught in higher schools in combination with the mother tongue, and used in interlingual correspondence and printed records. The resolution further authorized the officers of the association to pledge its co-operation in a general movement seeking that end, and to provide for its representation in any conference on the subject that may be called.

THE Guildford Natural History Society, England, is trying to have Walmer Forest set apart as a sanctuary for wild birds, in which they and their nests and eggs may remain unmolested throughout the year; that it may not be let at any time for game preserving or for any purpose hostile to birds; and that it remain in perpetuity a national memorial of Gilbert White.

A NOTICE, with portrait, of the late James Joseph Sylvester, Savilian professor of geometry in the University of Oxford, and formerly professor of mathematics in Johns Hopkins University, appears in the Proceedings of the Royal Society of London for May 9th. In the writer's opinion, Sylvester was one of the greatest mathematicians of all time, though it may be doubted whether he will take a place among those who "occupy absolutely the front rank" His greatest achievement was probably his paper entitled Algebraical Researches, printed in the Philosophical Transactions for 1864; but his published works do not properly represent his genius and greatness. He was so oppressed with floods of ideas that he was unable suitably to organize his researches. His personal character was one of singular beauty, and its salient points were simplicity and honesty.

A COPPER mask found inside the wrappings of a mummy pack in a grave at Chimbote, Peru, and in a valley thickly dotted with ancient cemeteries, is believed by Mr. George A. Dorsey to be unique. It was hammered from a single nugget of copper, and shaped by the aid of a mold or block. All the features are well formed and distinctive except the nose, which is pinched and dwarfed. A hole was made for the mouth, the ragged edges showing the method of the operation being still visible within.

A RATHER unusual competition is described by the Lancet as recently occurring in Milan. It seems that the nose possesses a peculiar significance for the Italians—so much, in fact, that they have a "cult of the nose," which has during the last seven years held two "*concorsi di nasi*" (nose competitions). The former of these was at Padua in 1891. The more recent one took place at Milan, when there were thirty-six competitors, the first prize being a gold medal.

WE have to record the deaths, not previously mentioned in the Monthly, among men known in science, of Dr. Joseph Albert Lintner, State Entomologist of New York since 1881, at Rome, Italy, May 5th, aged seventy-six years; Ch. W. A. Herrman, formerly professor of mineralogy in the University of Breslau, but since 1853 a resident of New York city, whose fine collection of minerals was widely known, June 21st, aged ninety-seven years; H. Perigal, treasurer of the Royal Meteorological Society and fellow of the Royal Astronomical Society, author of works on bicycloidal and other curves, kinematics and the laws of motion, etc., early in June, in his ninety-eighth year; Hubert Sadler, contributor to Knowledge, The English Mechanic, etc., fellow of the Royal Astronomical Society, in June, aged forty-two years; Osbert Salvin, F. R. S., an eminent English ornithologist and entomologist, Strickland curator in the University of Cambridge, one of the founders and editor of the third series of The Ibis, author of articles on Humming Birds and Petrels in the British Museum Catalogue of Birds, and joint author of *Biologia Centrali Americana*, still in progress, to which he contributed the results of three journeys of scientific investigation in Central American countries—June 1st, aged sixty-three years; the Rev. Percival Frost, mathematician, editor of Newton's *Principia*, and author of treatises on solid geometry and curve tracing, aged eighty years; Dr. George Bauer, associate professor of paleontology in the University of Chicago, at Munich, Bavaria, June 28th; Dr. Theodor Eimer, an eminent zoölogist, professor in the University of Tübingen, May 30th, aged thirty years; Sir James Nicholas Douglass, late engineer in chief at the Trinity House, superintendent of many important engineering works, and author of numerous improvements connected with lighthouses and their illuminating apparatus and in buoys and beacons, aged seventy-two years; Dr. Friedrich von Zenker, pathologist, who first, in 1860, discovered trichiniasis in the human body, and author of valuable medical works, at Erlangen, aged seventy-three years; Dr. Anton Kerner von Marilaun, professor of botany in the University of Vienna and author of the Natural History of Plants, aged sixty-seven years; and Professor Cohn, of Breslau, distinguished for his researches on algæ, and later for his studies and cultures of bacteria, aged seventy years.